TRANSACTIONS

OF THE

AMERICAN ASSOCIATION OF GENITO-URINARY SURGEONS

VOLUME XXIX

TRANSACTIONS

OF THE

AMERICAN ASSOCIATION OF GENITO-URINARY SURGEONS

Forty-eighth Annual Meeting held at
Stockbridge, Massachusetts

May 25, 26, and 27, 1936

Volume XXIX

Published for the Association by
The Bruce Publishing Company
Saint Paul and Minneapolis
1936

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PRESENTATION
of the
KEYES MEMORIAL MEDAL
to
DR. EDWARD L. KEYES

Stockbridge, Massachusetts
May 26, 1936

The Presentation of the Keyes Memorial Medal to Dr. Edward L. Keyes by the American Association of Genito-Urinary Surgeons took place on the lawn, Stockbridge, Massachusetts, at 12:50 o'clock, Tuesday, May 26, 1936.

PRESIDENT BARNEY: I will ask the meeting to come to order, please, because this is really a part of our meeting.

Members of the Association, Invited Guests and Ladies: We are about to witness a very pleasant ceremony, namely, the presentation of the Keyes Medal. This is to be done by Dr. William C. Quinby. Dr. Quinby!

DR. WILLIAM C. QUINBY:

> *"Sincerity is the way of Heaven; the wise are the unassuming. It is said of Virtue that over her embroidered robe she puts a plain single garment."*

Edward Loughborough Keyes—surgeon, teacher, author, public servant, friend of your fellow-man—you would be the first to disclaim any especial merit which warrants your being chosen recipient of this medal which bears your honored father's name. The medal stands as a token, a symbol of appreciation for work done and advances made in the field of Urology, and in spite of your protestation, you are the unanimous choice of this Society as the recipient of this its second award. In justification of this choice listen to the record:

Born in 1873, after a preliminary training by Jesuits, you entered Georgetown University from which you were graduated Bachelor of Arts in 1892 at the early age of nineteen years. Then followed

the degree of Doctor of Medicine from Columbia University (College of Physicians and Surgeons) in 1895. Later, in 1901, your Alma Mater still further set its stamp of approval on you by way of the Doctorate of Philosophy.

Then followed in steady succession evidence of your worth as: Lecturer on Urology at Georgetown Medical School, 1902-1906. Adjunct Professor of Urology in the New York Polyclinic Medical School, 1903-1908. Lecturer on Surgery in Cornell University Medical School, 1904-1910. Surgeon to St. Vincent's Hospital, 1905-1920; then Urologist from 1920-1932; and now on its consulting staff. Professor of Urology at the Bellevue Hospital Medical School, 1910-1911; and then at the Cornell University Medical School from 1911 till the present. Urologist to Bellevue Hospital, 1910-1924. Surgeon to the General Memorial Hospital, 1914-1917. Consulting Urologist to the Memorial, Bellevue, Nyack, St. Joseph's, Mercy and Staten Island Hospitals.

With the advent of war you entered as Major in the Medical Reserve Corps in 1917 and Director of the First Base Hospital. A Colonel in the Medical Corps in 1918, you became Consultant in Urology to the American Expeditionary Force in France. In 1919 you were transferred, still as Colonel, to the Medical Reserve Corps.

You are a Fellow of the Royal College of Surgeons of London and of the American College of Surgeons.

To this Society, the American Association of Genito-Urinary Surgeons, you were elected in 1901, and served as its president in 1912. Other societies also have carried your name on their roster:

The Society of Sanitary and Moral Prophylaxis of which you were president in 1913-1914. The International Surgical Association; the American Medical Association; the International Urological Society of which you have been president since 1927. The Clinical Society of Genito-Urinary Surgeons, of which you were president in 1923 and 1924. The American Urological Association, of which you became president in 1915. The American Social Hygiene Association, of which you became president in 1923. A member of the New York Academy of Medicine, you were elected to its vice presidency in 1921-1923. You are also a member of the Practitioners' Society and a Corresponding Member of the British, French, German, Belgian, Spanish, Portuguese and Italian Urologi-

cal Societies. And you are a holder of the Cross of the Legion of Honor.

This is a most enviable record, Sir, and, I submit, stands and will continue to stand for all time as a strong stimulus to both your contemporaries and successors of the younger generation.

Will you pardon me if I try to point out for those to come, who have not the good fortune of knowing you, one or two only of your traits which go to make up the flavor of your personality?

You are one of those fortunate mortals whose eyes have been "baptized into the grace and privilege of seeing." This has made possible your quick sympathy, your complete comprehension of the problem before you, whether that of patient or of colleague, and your wisdom in advice. This trait also explains the charming lucidity of your writings, especially that of your textbook which shines forth on every page, and which makes this work unrivaled for the use of the student, by any similar work either in this or in any other language.

And though this is much, you possess also humor, that "mixture of love and wit"; a most endearing attribute not given to all. Listen to what Crothers has to say of it:

> "Humor is impossible to the man of one idea. There must be at least two ideas moving in opposite directions, so that there may be a collision. Such an accident does not happen in a mind under economical management that runs only one train of thought a day."

And so, the American Association of Genito-Urinary Surgeons presents you with this medal as an appreciation of the good work for Urology which you have steadfastly done, together with the love and best wishes of each and every member.

Following the presentation of the medal, the audience arose and applauded.

Dr. Edward L. Keyes: My friends, and especially Dr. Quinby: I thank him for his poetry and for his appreciation of me, inasmuch as that appreciation began with the announcement that I had done as one of the revolutionary Frenchmen said of one of the seed of our nobles, I had given myself the pains to be born. I feel that from this lady (his mother), perhaps I may say, flows much of my distinction. (Applause)

The last remarks I made before we left the room at one side here, were in favor of freedom, progress and peace.

I believe in freedom, progress and peace. My son came here this morning, traveling many miles, kindly, to see this event, and he brought me good news—news that made me think how in the evil days that fall upon old age we find that as people grow older, they praise the more the olden times when they didn't know how happy they were. It is a pleasure to me not to make any effort to tell you further how nice I am, but rather to tell you a curious thing that he brought to me in connection with another curious thing which I got from Dr. Morris last week when we were fishing together. Dr. Morris was the medical end of Dr. McBurney who was the town's greatest surgeon when I was very young. Morris said that the first Listerian operation that was done in New York City perhaps, in Bellevue Hospital certainly, was an operation upon the knee joint done by Dr. Van Buren, who in medicine was my father's father.

The preparation for the operation was quaint. I can see Dr. Van Buren in his frock coat. I hope I can see him with a boutonniere as appropriate to the splendid occasion to which everybody had been gathered, for here Lister was first to be shown to the town. The preparation within the hospital, however, was not quite so elegant, for they were a bit cramped for space and just before the operation, Dr. Morris tells me, he had done a very interesting autopsy on the same table and on the same sheet on which the operation was to be done. Dr. Van Buren operated upon this knee joint amid many sprays. They used, you know, all sorts of things for sprays.

To digress, one of the jokes of those days referred to Dr. Post, who was a very slow surgeon and was a plastic surgeon. How it was possible in pus to do plastics, I don't know, but he was a plastic surgeon. He worked very slowly. On this occasion, subsequent to Dr. Van Buren's operation, evidently, he worked on this face for some time under a spray of oil of thyme, and it was in the summer and it was hot and it was full of flies. One indignant person in the audience, leaving in disgust, we will say, at the end of the first hour or two, said, "I never realized the connection between thyme and flies before." (Laughter.)

Dr. Van Buren, when he did his operation, announced that he would make the first dressing, as was his custom, before the clinic this day a week, and said that he felt sure that under this new cleanly method, he would obtain laudable pus. What was his sur-

prise and everyone else's when the bandages were removed to find the wound completely healed by first intention. It struck me as quite interesting.

Also interesting is the fact that my son brought me—he is adjacent, as you might say at the moment, working on diseases of the rectum; carcinoma of the rectum is his present interest. Among other things, the literature led him back to a book with which I am familiar, a book by Dr. Van Buren on diseases of the rectum. There he was surprised to find the record of a case of carcinoma of the rectum operated upon posteriorly. He has forgotten the date, but he says he thinks it is after this antiseptic era had begun, but operated upon posteriorly by E. L. Keyes and illustrated by Lewis A. Stimson, who was my beloved teacher and illustrated in such a way that he thinks (God knows whether he is right or not) he can detect that it was an adenocarcinoma that was operated upon. The record happily closes with the statement that the patient was alive at the end of a year and apparently well. I hope this present patient may be so, too. (Applause)

THE AMERICAN ASSOCIATION OF GENITO-URINARY SURGEONS

FIRST DAY, MAY 25, 1936

PROLONGED DRAINAGE OF THE URETER

GORDON S. FOULDS, M.D., F.R.C.S. (C)

Toronto, Canada

Urologists have recognized, for many years, the advantages of adequate and prolonged urinary drainage in the treatment of obstructive lesions of the lower urinary tract, and that the utilization of such drainage has greatly improved the results in the surgical management of prostatism. Nephrostomy is an established procedure as a preliminary measure in the preparation of the patient with a large pyonephrosis for nephrectomy and as a means of affording postoperative renal drainage. Cabot, particularly, has shown the value of such drainage after the removal of renal calculi, in reducing infection and thereby the probability of recurring stone formation.

Drainage of the upper urinary tract by indwelling ureteral catheter is likewise generally practiced in pyelitis of pregnancy and similar conditions as well as in the relief of back pressure during manipulative treatment of ureteral lithiasis. However, indwelling ureteral catheter drainage is feasible only over relatively short periods of time. These periods, nevertheless, are usually sufficient to obtain satisfactory results in the types of cases mentioned.

A group of cases remains in which more prolonged ureteral drainage is desirable. Those cases in which chronic obstruction and infection exist as a result of impacted ureteral calculus offer a definite field for such management. The factors which are present under these circumstances are in many ways similar to those demanding nephrostomy after the removal of a renal calculus or drainage of the common duct for the relief of hepatic dysfunction resulting from a stone lodged for some time in that passage. In the latter condition, the Kehr-Deaver T-tube has been proved to be of distinct advantage as a means of maintaining adequate and pro-

longed drainage of the biliary passages. The use of this tube in the ureter is neither new nor original. It has been used with considerable success in operations for the plastic repair of ureteral stricture by Von Lichtenberg and by Ormond. I am of the opinion that its usefulness may be extended by using it to provide more prolonged drainage of the upper urinary tract in obstructive lesions of the ureter, the chief of which is impacted calculus.

URETERAL CALCULUS

A calculus passing down the ureter invariably causes some degree of obstruction. This, however, is seldom of importance except in the presence of infection and where the obstruction is of long standing, such as is found when a ureteral stone is arrested above a stricture and becomes impacted. Peacock found 18 per cent of his cases impacted. Of the last 100 proven cases of ureteral stone admitted to St. Michael's Hospital, sixty-nine patients passed the stone at the time of examination or after the application of manipulative measures. In the remaining thirty-one patients, uretero-lithotomy was done, either because manipulative measures had failed or because they were considered to be inadvisable.

Of the thirty-one cases in which it was necessary to perform a uretero-lithotomy, there were eleven in which the stone was impacted and the ureter above it dilated with infected and purulent urine. The majority of these stones had been arrested in their descent by a stricture, or at the point where the ureter crosses the brim of the pelvis. In such cases there is a disparity in the size of the lumen above and below the site of the stone which is detrimental to satisfactory conduction of urine down the ureter. Thus, in these cases, closure of the ureter after removal of the stone does not prevent leakage and consequent soiling of the wound.

To obviate leakage and promote better drainage, it has been suggested that a ureteral catheter should be left in the ureter after operation. Cabot, in 1910, referred to the objection to this form of treatment by the French school, notably Albarran and Jeanbrau. Cabot feared the introduction of infection and found that such ureteral catheters frequently became blocked and so defeated the purpose for which they were used. Since then, many have used indwelling catheters in this way in occasional cases and, in 1931,

Barney and Chute recorded their use in four cases in a recent series and advised their more frequent employment in the presence of severe infection and ureteral dilatation.

Noting the similarity of the problem of providing better and more prolonged drainage in these cases, with that which exists in common duct obstruction, I have used the Kehr-Deaver T-tube in these eleven cases as well as in several others in private practice.

After the removal of the stone, any narrowing of the lumen of the ureter immediately distal to the calculus was dilated thoroughly or incised longitudinally; then a T-tube of suitable size was inserted into the ureter and the incision closed tightly about the stem of the tube. A glove finger drain was then placed down to the opening and the wound closed. As a free exit for the urine had been provided, there was no soiling of the depth of the wound which healed quickly and cleanly about the tube.

Each day the ureter was irrigated once or twice with a solution of 1 in 1,000 acriflavine or 1 per cent mercurochrome. With the relief of back pressure in the ureter and kidney, and free drainage of urine, renal function invariably improved, usually quite rapidly. This improvement followed closely the lessening of renal infection. In several instances it appeared inadvisable to leave the damaged kidney but because of bilateral stone formation which occurred in two cases, or serious functional impairment of the contralateral kidney, nephrectomy was postponed. In each case, improvement in function, together with the lessening of the infection, has been sufficient to warrant this decision, and further treatment by cystoscopic means has made possible the saving of the kidney.

Depending upon the degree of improvement, the tube has been left in place from ten to twenty-six days; the usual period was fourteen to sixteen days. Following its removal, there was little or no urinary drainage from the fistula. In only one case did urine continue to drain for more than two days. I believe that this patient would have been better had no drainage been instituted; the stone was situated at the uretero-vesical junction and the amount of ureteral dilatation was less than in the others.

URETERAL STRICTURE

In two cases, with impassable postoperative ureteral stricture, the T-tube has proved to be of great assistance.

Case 1.—The first of these was a young man who several years previously had had a calculus anuria. At that time stones were removed from both ureters and from the right kidney. There was also renal damage from an old standing chronic nephritis. Two months before consulting me he had complained of pain in the right loin. An impassable stricture had been found at the site of the previous operation on the right ureter at the point where it crossed the iliac vessels. Nephrectomy had been contemplated but on account of bilateral renal damage was postponed. After confirming the impassability of the stricture, I explored it and reconstructed the ureter over a T-tube on July 24, 1934. The urine at the time showed colon bacilli on culture and contained many pus cells. Since then the patient has been examined periodically by Dr. Seng of Montreal or myself, and for the past year cultures have been negative and at no time has there been any difficulty in passing a number eleven bougie up the ureter.

Case 2.—The second case was one of my own in which a stone had been removed from the lower end of the left ureter and no ureteral drainage provided. The fistula persisted and though roentgenograms showed that there was no further stone it was impossible after several attempts to catheterize the ureter. In this case the ureter was isolated and opened higher up. Dilatation of the stricture was commenced with a fine catheter and carried on until a No. 18 urethral bougie could be passed. A T-tube was left in place for ten days with the lower arm well down toward the bladder. The fistula closed promptly after its removal and catheterization of the ureter has been possible since.

RENAL INFECTION

It is probable that temporary ureterostomy of this sort will seldom be advisable for relief of renal infection except in the presence of definite obstruction in the ureter. However, three years ago a urological colleague called me to see a young man who had bilateral chronic pyelonephritis with a high degree of renal damage. He was suffering from a severe acute exacerbation of infection in the left kidney, which was the better one functionally. Improvement had been marked after drainage was instituted by the cystoscopic placing of an indwelling ureteral catheter but because of lack of cooperation on the part of the patient the catheter was retained for twenty-four to forty-eight hours only. After four attempts to obtain adequate drainage in this way the patient had refused further cystoscopy and a nephrostomy had been considered. I advised a temporary ureterostomy with T-tube drainage, which was carried

out, the tube being placed just above the junction of the upper and middle thirds of the ureter. Improvement was satisfactory and drainage was maintained for seventeen days. Though still exhibiting considerable pyuria, the patient is carrying on fair health and still fails to coöperate in any further cystoscopic treatment. Though I shall probably not have occasion to repeat this experience, I do feel that the procedure saved the day on this occasion.

CONCLUSIONS

Prolonged drainage of the lower urinary tract has long been accepted as a valuable procedure in lower urinary obstruction.

Drainage of the kidney by nephrostomy after the removal of renal calculi is advisable in certain cases as a means of promoting better function and decreasing infection.

The use of the indwelling ureteral catheter is recognized in the treatment of pyelitis of pregnancy and other upper urinary tract infections.

In cases with impacted stones in the ureter with infection in the kidney and dilatation of the ureter, temporary ureterostomy with a T-tube offers a means of providing sufficiently prolonged drainage of the ureter to allow improvement in renal function to occur and renal infection to subside.

The T-tube is of use in the reconstruction of the ureter after operation for impassable stricture.

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DUPLICATION OF THE LOWER URETER ENDING BLINDLY

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One of the less commonly recognized anomalies of the urinary tract is the duplicated lower ureter with one ending blindly. Generally speaking this anomaly is included in the literature under ureteral diverticula and is discussed along with ureteral cysts, dilatations and outpouchings of every sort. In 1933 Kretschmer presented an excellent discussion of this condition and reported an autopsy specimen in which it existed on both sides. He emphasized the difference between this and other types of ureteral pathology and thought this should be considered a definite and distinct entity.

No attempt will be made to review the literature inasmuch as this has been done so recently and so completely by Kretschmer. Since his report one additional case has been reported by Crenshaw.

We desire to present two case reports representing this condition, though it should be stated in the beginning that in neither case was the diagnosis confirmed either by surgical exploration or by autopsy.

CASE REPORTS

Case 1.—H. L., a man twenty-four years of age, entered the Wisconsin General Hospital on July 2, 1933, complaining of pain in the right chest. In February, 1933, he experienced a spontaneous pneumothorax while lifting a heavy object and before entry to the hospital had had a drainage tube placed in the pleural cavity. There were no complaints referable to the urinary tract.

Physical examination revealed nothing significant, except in the chest.

Urinalysis on admission showed a specific gravity of 1.012; reaction, acid; no albumin; no sugar; many urates; and one or two white blood cells in a microscopic field.

The diagnosis was empyema due to sepsis occurring in an effusion. In treating this condition rib resection and other measures were carried out.

In February, 1934, blood and some pus were found in the urine and a member of the Department of Urology was called in consultation.

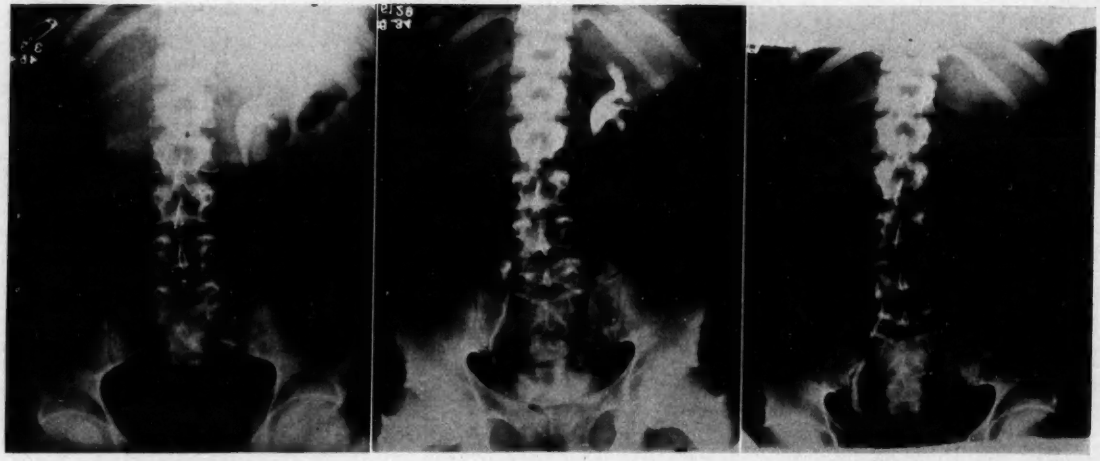

Fig. 1. Case 1. Excretory urogram showing normal pelves. The ureter with blind ending is not shown.

Fig. 2. Case 1. Retrograde pyeloureterogram. On the right side the catheter entered the ureter with blind ending. No medium entered the normal ureter.

Fig. 3. Case 1. Right pyeloureterogram made with tip of catheter just within the right ureteral orifice. Both right ureters are shown.

On March 28, 1934, a cystoscopic examination was done. The bladder appeared normal. The left ureter was catheterized easily. An obstruction was encountered in the right ureter about six centimeters above the meatus. Specimens taken from both sides were sterile on culture. A left pyelo-ureterogram appeared normal. No pyelogram was taken on the right side at that time.

Two days later an excretory urogram showed normal pelves and calices on both sides. The lower ureters were not filled.

On July 16, 1934, another cystoscopic examination was made and again an obstruction was encountered on the right side about six centimeters above the meatus. However, on this occasion an opaque medium was injected through the right catheter and the ureter was found to be filled to the level of the top of the fifth lumbar vertebra where it ended with a bulb-like dilatation more than a centimeter in diameter. Numerous stains and guinea pig inoculations gave negative findings for tuberculosis.

On July 20, 1934, excretory urograms were again made, and again satisfactory filling in both renal pelves indicated that they were normal in size and contour. On July 22, 1934, another cystoscopic examination was performed, and at this time a No. 10 French bulb catheter was introduced just through the right ureteral orifice and a retrograde pyelo-ureterogram was made. This showed a duplication of the ureter beginning just above the bladder, one branch ending in a blunt dilatation, the other ending normally at the kidney as seen in the excretory urograms.

This patient had no urinary symptoms at any time except hematuria. This was discovered on February 23, 1934, and persisted until about June 29, 1934. Following this it appeared intermittently.

Case 2.—F. S., a white woman, thirty-eight years of age, had complained of a dull pain over the left renal area for eight to ten years. Several cystoscopic examinations were made at long intervals; but, with the exception of one attack of pyelonephritis of pregnancy, the kidneys were found to be uninfected and pyelo-ureterograms appeared normal. Cholelithiasis was known to exist; and, as no pathologic change could be demonstrated in the left kidney, it was assumed that the pain was due to an atypical radiation from the gall bladder. However, cholecystectomy, in 1934, did not relieve the pain. In 1934 gross hematuria was noticed, and it has recurred several times since. There had been no other urinary complaints.

Physical examination revealed nothing significant.

Because of the appearance of gross hematuria complete cystoscopic studies were repeated on May 21, 1934. Again the bladder appeared normal, ureteral specimens gave negative findings on microscopic examination and culture, and functional studies revealed normal function. However, for the first time a retrograde pyelo-ureterogram showed a second ureter on the left side lying for the most part lateral to the true ureter. It appeared to join the other ureter near

Fig. 4. Case 2. Retrograde pyeloureterogram taken in 1929. The kidney and ureter appear normal.

Fig. 5. Case 2. Retrograde pyeloureterogram taken in 1934. The duplicated ureters are seen on the right side. One ends blindly.

Fig. 6. Case 2. Excretory urogram made in 1934. The ureter with blind ending is not shown.

the urinary bladder and ended in a smooth bulb-like formation at the level of the upper margin of the third lumbar vertebra.

Three days later excretory urograms failed to show the blind ending ureter.

EMBRYOLOGY

This condition is a developmental anomaly. As pointed out by Kretschmer, there are two theories set forth to explain this type of duplication: a premature or exaggerated cleavage of a single ureteral bud, or the occurrence of duplicated ureteral buds arising from the wolffian duct. He states, "The factors which initiate these deviations from the usual course of development and which abort the growth of one of the branches of the bifid ureter, causing it to end blindly, are not known."

In Kretschmer's case the accessory ureters ended in a thread-like prolongation, there being no evidence of renal tissue other than the normal kidneys. In the autopsy specimen by Wilhelmj, the blind ureter ended in a "small ragged fibrous mass of tissue located on the superior, posterior, and medical aspects of the normal kidney." Histologic studies of this mass revealed "some structures which seemed to resemble ovarian stroma and others which resembled tubules and calices." However, no glomerular structures were found. Wilhelmj also reported a case of Ebstein, cited by Morris, in which "a pale reddish mass of connective tissue surrounded by adipose tissue" was located at the upper end of a blind ending ureter. On histologic examination no uriniferous tubules or glomeruli could be discovered although there was "a very narrow ureter, renal pelvis, and a very small representative of a renal artery." Ebstein considered this as a rudimentary development of a kidney rather than an absent kidney. In Neff's case the accessory ureter ended blindly in the presacral fat. He concluded that this ureter failed to receive a cap of mesodermal tissue. Law and Henline, in 1930, reported a case in which three ureteral orifices were found. Two were on the right; one was easily catheterized, but an impassable obstruction was encountered in the other. From their complete studies they assumed that this third ureter either ended blindly or possibly passed to an aplastic ectopic kidney about the level of the crest of the ilium. They believed that the "proliferative stimulus," which usually caused a ureteral bud to follow the nephrogenic cells upwards to form a complete system, was lacking in this third ureteral bud

either because of insufficient nephrogenic cells or because of the great distance between it and the metanephros.

SYMPTOMATOLOGY

Unfortunately, characteristic symptoms do not occur with this condition. In both of our cases hematuria was the important symptom. One patient suffered a mild degree of pain; the other had no pain.

DIAGNOSIS

Our experiences with these two patients seem to justify the statement that neither excretory urograms nor the usual retrograde pyelo-ureterograms will reveal these blind ending ureters, except when the ureteral catheter enters the ureter with the blind ending as in our first case. When this occurs, a retrograde injection will, of course show the blind ending ureter, and the normal pelvis will be shown by the excretory urogram.

However, the use of the retrograde pyelo-ureterogram made with a large catheter or bulb just within the ureteral orifice is the method of choice and is most apt to reveal the condition. Since this procedure is not used routinely in urologic diagnosis, it may be that this anomaly is more common than we have believed.

CONCLUSIONS

1. The duplicated ureter ending blindly is a definite clinical entity and should not be considered with ureteral diverticula (as pointed out by Kretschmer.)

2. Hematuria was the important symptom in our cases; hence this condition must be thought of when hematuria cannot be otherwise explained.

3. Excretory urography is valueless as a diagnostic procedure in this condition.

4. Diagnosis can best be made by retrograde pyelo-ureterography, using a bulb or large catheter snugly placed just within the ureteral meatus.

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A CRITICAL STUDY OF THE DIFFERENT PRINCIPLES OF SURGERY WHICH HAVE BEEN USED IN URETERO-INTESTINAL IMPLANTATION

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The following study of the literature upon uretero-intestinal anastomosis was undertaken with the object of gaining a better understanding of the surgical problem. Eighty years have elapsed since Simon made the first attempt to divert the urine to the bowel and in this time more than 1,000 such operations have been performed. Surely something of the surgical principles involved must have been learned. The historical reviews which have appeared from time to time* list more or less chronologically the various methods which have been used without distinguishing the principles of surgery upon which each of the different methods is based. Such an analysis leaves something to be desired because the historical material is of importance to the surgeon of today only insofar as it teaches the way to implant ureters more successfully than has been done in the past and in what particulars even the most successful methods are at fault. It must be admitted that the implantation of the ureters into the intestinal tract is a serious procedure. A few surgeons maintain that the operation always will be dangerous and consequently forever impractical. Naturally every surgeon wants to know whether the procedure is less serious now than it was and, if so, whether improvement is attributable to the introduction and application of newer, better principles of surgery. He then wants to know what these different surgical principles are and why they were advocated. This degree of understanding of the problem is the object of the present study.

All methods for the ureteral diversion of urine may be grouped under the following classification:

*Peterson, 1900; Steinke, 1909; Buchanan, 1909; Sembianti, 1915; Mayo, 1920; Papin, 1925.

I. Non-intestinal
   A. To the skin
   B. To other structures
      1. Urethra
      2. Vagina
      3. Fallopian tube
      4. Uterus
      5. Blood vessel
      6. Meninges of spinal cord

II. Intestinal
   A. Into an excluded portion of the tract
      1. Completely excluded portion
      2. Partially excluded portion
   B. Into the intact tract

Non-intestinal methods of ureteral implantation are not a part of this study. Implantations to the skin, which perhaps do not seriously endanger the life of the patient at the time of operation, permanently place a burden of care and discomfort because of incontinence. The formation of a vesicovaginal fistula is no more than a temporizing measure and implantations to other structures are obviously without merit.

Of the intestinal methods for the ureteral diversion of urine, those to the intact tract have been used most often and fulfill best the surgical requirements. Consideration of these methods forms the major part of this study. For the sake of completeness the surgical principle of creating a bladder by the isolation of a portion of the bowel or of forming a urinary channel by transplanting the ureters into a partially excluded portion in order that the ends of the ureters will not come into direct contact with the fecal stream is given brief consideration.

Part I. Uretero-intestinal Implantation into an Excluded Portion of the Intestinal Tract

Diversion of the fecal stream so as to diminish ascending infection was the idea which prompted partial exclusion of portions of the intestine into which to implant ureters. This surgical principle is discussed subsequently in connection with colostomy preliminary to implantation. The French and German surgeons who advocated complete exclusion had in mind, however, the production of an artificial bladder which, according to Heitz-Boyer and Hovelacque, should assure continence, possess a free,

unobstructed excretory canal and be accessible for instrumental exploration. With these criteria (as the main objects) the methods can be classified according to the type of exclusion of the bowel without reference to the method of ureteral implantation,† as follows:

1. Implantation of the ureters into a completely excluded portion of the intestinal tract.
   a. An artificial bladder made from the small gut.
      (1) Placed under control of the vesical sphincter (experimental only. Tizzoni and Foggi, 1888.
      (2) With the end brought out through the anal sphincter. Cuneo, 1911.
   b. An artificial bladder made from the entire rectum.
      (1) Iliac sigmoidostomy. Mauclaire, 1894.
      (2) With the sigmoid drawn through the anal sphincter. Gersuny, 1898.
      (3) With the excluded rectum made to communicate with the urethra for control by the sphincter. Lemoine, 1912.
   c. An artificial bladder made from a pouch of the anterior rectum (experimental only). Lotheisen, 1899.
   d. An artificial bladder made from the ileocecal region, the appendix serving as a urethra. Verhoogen, 1908.

2. Implantation of the ureters into a partially excluded portion of the intestinal tract.
   a. A blind pouch of the lower ileum emptying into:
      (1) The ileum. (Experimental only.) Nagano, 1901.
      (2) The cecum. Goldenberg, 1904.
      (3) The transverse colon. Moskowicz, 1909.
      (4) The sigmoid. Berg, 1907.
   b. A blind pouch of short-circuited loop of the sigmoid. Borelius-Berglund, 1903.
   c. A blind pouch of the sigmoid emptying into:
      (1) The lower sigmoid. Müller, 1903.
      (2) The rectum. Muscatello, 1904.
   d. A blind pouch of the upper rectum. (Experimental only.) Descomps, 1909.

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†The method of ureteral implantation in conjunction with an exclusion operation is referred to in Part I under the name of the originator, as "Maydl" or "Stiles"; or after the classification of surgical principles of Part II of this paper, as "direct" (the second surgical principle).

1. IMPLANTATION OF THE URETERS INTO A COMPLETELY EXCLUDED PORTION OF THE INTESTINAL TRACT

a. An artificial bladder made from the small gut.

(1) *Placed under the control of the vesical sphincter.*

The earliest attempt to form an artificial bladder was made by Tizzoni and Foggi, in 1888. Operating upon one dog, these workers completely isolated a loop of small intestine, 7 cm. long, which they lavaged and converted into a closed pouch by uniting the two ends. The continuity of the intestinal tract was reëstablished by an anastomosis of the remaining ends. One month later the ureters were transplanted (by a method not stated) into this blind loop which, in turn, was sutured to the neck of the bladder. The animal was alive and well two months later. In a second dog, the entire operation was attempted in one stage, death ensuing eight days after operation.

(2) *With the end brought out through the anal sphincter.*

The first clinical operation using the small intestine as a completely isolated urinary reservoir was devised by Cuneo, in 1911 (Fig. 1-A). By the perineal route the rectal mucosa was dissected free anteriorly, making a cavity 4 or 5 cm. long which was to serve as an opening for the new bladder. Immediately proceeding with the abdominal part of the operation, a loop of small gut, from 18 to 20 cm. long, taken from a point 20 cm. above the ileocecal valve, was isolated, preserving the mesentery. The continuity of the intestine was next reëstablished by a circular entorrhapy and the proximal end of the excluded loop was closed. The distal end of the loop was drawn, by means of a Kocher clamp, through the opening which had been made previously anterior to the rectum, and the edges were sutured to the anal mucosa. Cuneo advised against resecting the excess of ileal mucosa forming a partition with the anus because retraction and scar formation draw up the inferior portion of this partition, resulting in an incomplete division of the rectum and new bladder.

At a second operation, six weeks later, the ureters were implanted into the excluded pouch intraperitoneally by the technic of Maydl or Bergenhem.

Three cases of exstrophy of the bladder, treated by this method, resulted in the death of one patient from peritonitis. The two

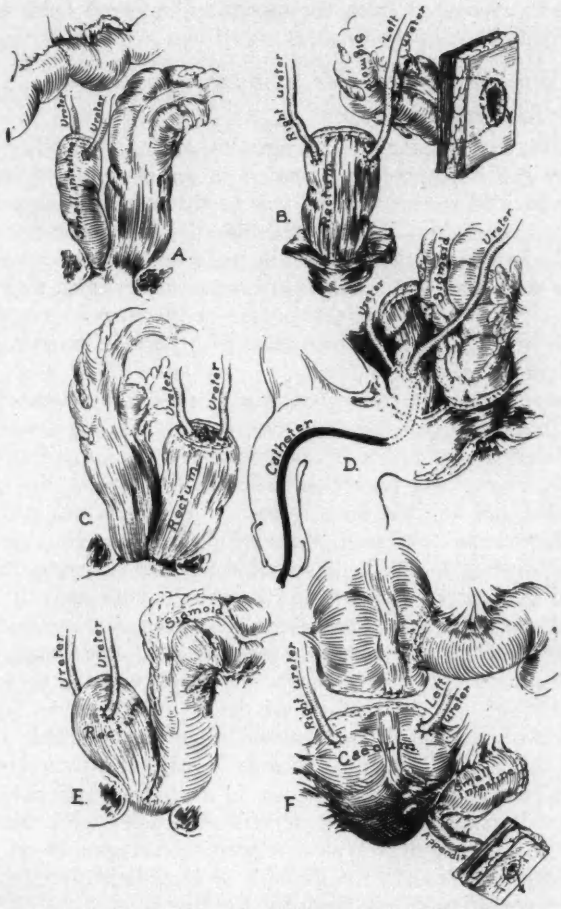

Fig. 1. Implantation of the ureters into an artificial bladder formed from a completely excluded portion of the intestinal tract. *A*, Method of Cuneo; *B*, method of Mauclaire-Krönig; *C*, method of Gersuny; *D*, method of Lemoine; *E*, method of Lotheisen; *F*, method of Verhoogen.

A. Artificial bladder from small gut; one end is brought out through the anal sphincter, the other end is closed and the ureters are implanted into it by the method of Bergenhem.

B. Artificial bladder from entire rectum; after iliac sigmoidostomy; ureters implanted by the direct method.

C. Artificial bladder from entire rectum with the proximal end of the rectosigmoid drawn through the anal sphincter alongside this excluded portion. The ureters are implanted by the method of Maydl.

D. Artificial bladder from entire rectum made to communicate with the urethra for sphincter control. The ureters are implanted by the direct method.

E. Artificial bladder from pouch of anterior rectum. The ureters are implanted obliquely.

F. Artificial bladder from ileocecal region, the appendix serving as a urethra. Direct implantation of the ureters is made into the excluded portion of the cecum.

patients who recovered from the operation, suffered from urinary fistulæ (Table I).

b. An artificial bladder made from the entire rectum.

(1) *Iliac sigmoidostomy*

Mauclaire, in 1895, experimenting with dogs, completely isolated the rectum and implanted both ureters in the invaginated superior end. The divided end of sigmoid was used to establish an artificial anus in the iliac region. He advised the use of ureterorectal catheters which, he claimed, permitted the surgeon to make an oblique implant in the rectal wall, and, at the same time served to irrigate the newly formed bladder. Although he performed no clinical operations, he suggested the formation of a perineal anus with the divided sigmoid in man.

The first clinical application was made in 1905, by Remedi, who executed the entire procedure in one stage. Krönig, two years later, modified the operation to incorporate two stages (Fig. 1-B). In the first, carried out twelve days before the second, the rectum was excluded and the iliac anus formed. At the second operation, he transplanted the ureters to the excluded rectum by the direct method. Rovsing, in 1915, described a similar two-stage technic except that the ureters were transplanted by Maydl's procedure. In applying the method to patients suffering from carcinoma of the bladder, Schmieden performed the operation in three stages, the third stage consisting of cystectomy. He implanted the ureters, at the second stage, by the method of Stiles. Eight cases by this method yielded a surgical mortality of 25 per cent (Table I).

In 1923, Myles recommended an inguinal sigmoidostomy following ureteral transplant in order to avoid ascending infection. He claimed that implantation of the ureters was easier with the colon intact. In advising against Myles' suggestion, Dagger, in the same year, considered it wiser to run the risk of ascending infection than to burden a patient with a colostomy for life.

(2) *With the sigmoid drawn through the anal sphincter.*

Still using the completely isolated rectum as a urinary reservoir, Gersuny, in 1898, devised an operation intended to maintain fecal, as well as urinary continence (Fig. 1-C). He first isolated the rectum and implanted the trigone in the divided lumen, after Maydl's method. The sigmoid was then drawn through an open-

ing made along the anterior margin of the anus and anchored within the anal sphincter so that this structure controlled both the newly formed bladder and the sigmoid, which served as rectum.

In 1910, Heitz-Boyer and Hovelacque described their carefully designed anatomic operation which differed from Gersuny's technic in that the coccyx was resected and the sigmoid drawn through an opening made posterior to the rectum within the anal sphincter, rather than anterior to it. They stressed the importance of conserving the blood supply to the rectum, the sigmoid and the ureters. The ureters were implanted separately by the direct coaptation of mucosa to mucosa. Mikuli, in 1930, described a similar method.

Lastaria, in 1913, modified the Heitz-Boyer and Hovelacque operation by stripping the muscularis and serosa from that part of the bowel placed between the sphincter and the rectal mucosa. This procedure was carried out in order to avoid overstretching of the anal sphincter by a reduction in the volume of the mass penetrating it.

Melnikoff, in 1924, modified Gersuny's technic by fashioning the skin of the perineum into a channel intended to serve as a urethra for the newly formed bladder. He maintained that such a channel, opening at a distance from the anus, minimized the danger of ascending infection.

Five cases have been reported in which the various modifications of Gersuny's procedure were used, with two surgical deaths, a mortality of 40 per cent (Table I).

(3) *With the excluded rectum made to communicate with the urethra for control by the sphincter.*

Lemoine, in 1913, after performing a cystectomy for carcinoma of the bladder, completely isolated the rectum, according to the technic of Heitz-Boyer and Hovelacque, and joined it to the posterior urethra which had been left free at the time of the cystectomy (Fig. 1-D). The ureters were transplanted directly. He hoped that this method would result in more satisfactory urinary control, although he was unable to determine this because the patient died before the perineal wound healed. Death resulted eighteen days after operation from renal infection and insufficient lowering of the sigmoid, which allowed the escape of feces into the perineal wound (Table I).

TABLE I

Classification	Method of Bowel Exclusion	Type of Ureteral Transplant	No. of Operations	Diagnosis	Date	Operator	Complications	Result			Reported by
								Well	Surgical Death	Late Death	
(1)	Experimental										
a(2)	Cuneo	Bergenhem	2	Exstrophy of bladder		Cuneo	Urinary fistula	Recovered from op.			Marion, 1912
	Cuneo	Maydl	4	Exstrophy of bladder	1911	Cuneo	Urinary fistula	Recovered from op.			Marion, 1912
	Cuneo	Maydl		Exstrophy of bladder	1917	Kotzenberg			Peritonitis		Kotzenberg, 1917
Results: 3 cases of Exstrophy of bladder. 1 Surgical death, 33⅓ per cent mortality.											
b(1)	Mauclaire	Direct	1	Exstrophy of bladder	1905	Remedi			Renal infection & obstruction, 4 days		Remedi, 1906
	Mauclaire	Maydl	2	Exstrophy of bladder	1915	Rovsing		Recovered from op.			Rovsing, 1906
Results: 2 cases of Exstrophy of bladder. 1 Surgical death, 50 per cent mortality.											
	Mauclaire	Direct	2	Sarcoma of uterus		Krönig		4 months			Krönig, 1907
	Mauclaire	Direct	1	Carcinoma of bladder		Latzko			Uremia		Latzko, 1910
	Mauclaire		1	Carcinoma of uterus and bladder		Payr		7 months			Payr, 1914
	Mauclaire		1	Carcinoma of uterus and bladder		Payr		6 months			Payr, 1914

	Mauclaire	Stiles	2	Aniline carcinoma of bladder	1921	Schmieden	Metastasis in abdominal scar	1½ years			Schmieden, 1923
	Mauclaire	Stiles	3	Carcinoma of bladder	1922	Schmieden Scheele				Renal infection & obstruction; pneumonia, 5 months	Schmieden, 1923
	Results: 6 cases of Malignancy. 1 Surgical death, 17 per cent mortality.										
b(2)	Gersuny	Maydl	2	Exstrophy of bladder	1898	Gersuny			Renal infection, 5 days		Warbasse, 1899
	Heitz-Boyer, Hovelacque	Direct	1	Exstrophy of bladder		Gosset		2 months			Gosset, 1913
	Heitz-Boyer, Hovelacque	Direct	1	Vesico-vaginal fistula	1912	Gregoire		1 year, 8 mos.			Gregoire, 1914
	Heitz-Boyer, Hovelacque	Direct	1	Exstrophy of bladder	1910	Marion	Renal infection	1 year, 8 mos.			Heitz-Boyer and Hovelacque, 1912
	Heitz-Boyer, Hovelacque	Direct	1	Exstrophy of bladder	1912	Villiet			Renal infection & peritonitis, 3 days		Villiet, 1913
	Results: 5 cases of Congenital Anomalies and Trauma. 2 Surgical deaths, 40 per cent mortality.										
b(3)	Lemoine		2		1912	Lemoine			Renal infection. Separation of sigmoid with escape of feces into perineal wound, 18 days		Lemoine, 1913
	Result: 1 case of Malignancy. 1 Surgical death, 100 per cent mortality.										

Classification	Method of Bowel Exclusion	Type of Ureteral Transplant	No. of Operations	Diagnosis	Date	Operator	Complications	Result: Well	Result: Surgical Death	Result: Late Death	Reported by
c	Experimental										
d	Verhoogen	Maydl		Exstrophy of bladder		Fink			Operative shock		Fink, 1910
	Lengemann	Maydl	2	Exstrophy of bladder	1913	Fründ			Peritonitis, renal infection and obstruction		Fründ, 1916
	Lengemann	Maydl	2	Exstrophy of bladder	1913	Machal	Urinary fistula	1 year			Fründ, 1916
	Makkas	Maydl	2	Exstrophy of bladder	1910	Makkas	Renal infection, calculi in cecum	4 years			Makkas, 1910 Fründ, 1916
	Lengemann	Maydl	2	Exstrophy of bladder	1913	Machal	Urinary fistula	Recovered from op.			Fründ, 1916
	Case preparatory to ureteral transplant:										
	Makkas	None	1	Exstrophy of bladder	1912	Makkas			Peritonitis, 4 days		Fründ, 1916
Results: 6 cases of Exstrophy of bladder. 3 Surgical deaths, 50 per cent mortality.											
	Makkas	Maydl		Carcinoma of bladder		deGraewe			Died		deGraewe, 1908 (cit. by Zesas, 1909)

Makkas	Maydl		Carcinoma of bladder	1908	deGraewe			2 days		deGraewe, 1908 (cit. by Zesas, 1909)
Lengemann	Maydl	2	Carcinoma of bladder	1913	Lengemann		Recovered from op.			Lengemann, 1913
Makkas	Maydl	3	Carcinoma of bladder	1921	Rubritius			2 days		Scheele, 1923
Makkas	Maydl	1	Carcinoma of bladder		Lengemann			Uremia, 4 days		Lengemann, 1909
Verhoogen		1	Carcinoma of bladder	1908	Verhoogen			Renal obstruction		Verhoogen, 1908
Verhoogen		1	Carcinoma of bladder	1908	Verhoogen			Renal obstruction		Verhoogen, 1908

Results: 7 cases of Malignancy. 6 Surgical deaths, 86 per cent mortality.

Method of Operation	Exstrophy			Malignancy		
	Cases	Deaths	Mortality	Cases	Deaths	Mortality
a(2)	3	1	33⅓%			
b(1)	2	1	50%	6	1	17%
b(2)	5	2	40%			
b(3)				1	1	100%
d	6	3	50%	7	6	86%
Total	16	7	43%	14	8	57%

30 cases. 15 deaths, 50 per cent mortality.

c. An artificial bladder made from a pouch of anterior rectum.

In 1899, Lotheisen devised an operation on cadavers and animals which consisted in transplanting the ureters to a completely excluded pouch made from the anterior rectal wall (Fig. 1-E). Through a curved perineal incision, he freed the bladder from the rectum and divided the ureters. The anterior rectal wall was grasped as high as possible and drawn down through the anus. Layers of sutures were placed so as to isolate, completely, this anterior pouch from the posterior rectal canal which still served for the conduction of feces. The ureters were implanted in the fundus of the newly created bladder in an oblique course. Lotheisen considered this operation to be simpler, less dangerous and more satisfactory than Gersuny's. It has not been performed clinically.

d. An artificial bladder made from the ileocecal region, the appendix serving as a urethra.

In 1908, Verhoogen devised an operation which consisted of complete isolation of the ileocecal region and utilization of the appendix as a urethra (Fig. 1-F). The ileum was divided proximal to the ileocecal valve and anastomosed to the hepatic flexure of the colon just distal to the point of division of this structure. Both ureters were implanted separately into the cecum. The appendix was brought out through the skin in the right inguinal region so that the new bladder could be catheterized and irrigated periodically. Verhoogen performed the operation in two cases of carcinoma of the bladder, both of which terminated fatally.

The first successful operation by this principle was performed by Makkas, in 1910. He divided the procedure into two stages, executed one month apart, and modified the technic in two ways. At the first stage he formed an artificial bladder in the manner of Verhoogen, performing a side-to-side anastomosis of ileum, however, to the midportion of the transverse colon, rather than to the ascending colon. At the second operation, instead of implanting the ureters separately, he transplanted the entire trigone to the posterior wall of the newly formed bladder.

Taddei, in 1910, developed an operation in cadavers similar to Verhoogen's except that the ureters were transplanted, extraperitoneally, by the Bergenhem procedure to the excluded cecum. In 1912, he reported experimental work on dogs by a similar technic. Although the majority died of peritonitis following the ex-

clusion operation, a few survived long enough for him to implant the right ureter into the new bladder.

Lengemann, in 1912, further modified the Verhoogen-Makkas technic by isolating 30 cm. of ileum with the cecum into which he implanted the trigone extraperitoneally at a second operation. He claimed that the ileocecal cap and the peristalsis of the length of ileum offered a good defense against damming up, and temporary infection of urine, and that the end of the 30 cm. of ileum was so movable as readily to permit the implantation of the left ureter without stretching or jeopardizing the blood supply.

Twelve cases in which this type of procedure was used, resulted in eight operative deaths, or a mortality of 66 per cent. An additional patient succumbed following exclusion of the cecum prior to ureteral transplantation (See Table I).

Clinical Summary.—In the literature are found the reports of thirty patients operated on by five different methods of forming an artificial bladder, with fifteen deaths, a surgical mortality of 50 per cent. (The indication for operation was exstrophy of the bladder or vesicovaginal fistula in sixteen, and malignancy of the bladder or uterus in fourteen. Seven patients of the first group and eight of the second died as a result of operation.)

Discussion.—There seems to be no justification, either in theory or practice, for the formation of an artificial bladder preliminary to ureteral implantation.

2. IMPLANTATION OF URETERS INTO A PARTIALLY EXCLUDED PORTION OF THE INTESTINAL TRACT

a. A blind pouch of the lower ileum empting into:

(1) *The ileum*

The first operations based on the principle of partial exclusion of a portion of the intestinal tract were carried out in dogs by Nagano, in 1901 and 1902. He divided the lower ileum and, allowing 12 cm. to form a blind pocket, reconstructed the small gut by a side-to-side anastomosis. The ureters were then implanted by the Maydl method to the mid or upper portion of the partially excluded loop. Of six animals, none survived longer than eight days, death, in five instances, resulting from peritonitis.

(2) *The Cecum*

Goldenburg, in 1904, devised and practiced a partial exclusion of the ileum in one dog. The ileum was divided a short distance from the cecum and the proximal end was reimplanted just above the valves of Bauhin. The distal end was then brought out through a skin incision and the ureters were implanted after the method of Maydl. The resulting defect was to be closed in a subsequent plastic operation which was never carried out because of death from evisceration on the fourth postoperative day.

A clinical operation of this type was performed by Blair in 1916. In the first stage he divided the ileum 10 inches above the cecum. The divided end of the distal segment was closed by suture, the proximal end being anastomosed to the ascending colon. Three months later the trigone was implanted into the lateral wall of the blind loop of ileum. The patient was well one year later but succumbed to uremia fifteen months after the operation (See Table II).

(3) *The transverse colon*

Moskowicz, in 1909, described a method whereby the ileum was divided and the proximal end anastomosed to the transverse colon. The ureters were implanted in the distal lumen of the divided ileum, after Maydl's method.

Spannaus, in 1911, modified Moskowicz's operation by extraperitonealizing the ureteral transplant.

In three clinical cases, one surgical and one late death occurred (see Table II).

(4) *The sigmoid*

Berg, in 1907, isolated a loop of small gut, one end of which he diverted into the sigmoid (Fig. 2, A and A'). At a subsequent operation, he implanted the trigone, extraperitoneally, into the side of the excluded loop. Of five patients, two recovered (See Table II).

b. A blind pouch of short-circuited loop of the sigmoid.

Borelius, in 1905, acting upon a suggestion made by his assistant, Berglund, devised a method of partially excluding a loop of sigmoid by a side-to-side anastomosis at its base (Fig. 2-B). The ureters were anastomosed to the dome of the loop by the Maydl procedure.

Misch, in 1907, modified the Borelius-Berglund operation by placing a ligature above the site of the ureteral implantation in the loop of short-circuited sigmoid. His intention was to prevent the reflux of fecal matter to the region of the ureteral orifices.

In a group of six patients treated by these methods there were three surgical deaths (Table II).

Fig. 2. Implantation of ureters into a partially excluded portion of the intestinal tract. *A*, Method of Berg; *B*, method of Borelius-Berglund; *C*, method of Müller; *D*, method of Descomps.

A. Lateral anastomosis of ileum at the point where portion was resected.

A.¹ Excluded loop made from a portion of the lower ileum. The trigone has been implanted in the blind pouch.

B. A loop of sigmoid has been short-circuited, as shown by the arrow, and the trigone has been implanted into the dome of this loop.

C. The sigmoid has been divided and an end-to-side anastomosis made. The trigone has been implanted into the distal blind end of the sigmoid.

D. The recto-sigmoid has been divided and an end-to-side anastomosis of the sigmoid to the mid-portion of the rectum made. The ureters have been implanted into the blind end of the upper rectum by the direct principle of mucosa to mucosa.

TABLE II

Classification	Method of Bowel Exclusion	Type of Ureteral Transplant	No. of Operations	Diagnosis	Date	Operator	Complications	Well	Surgical Death	Late Death	Reported by
a(1)	Experimental										
a(2)	Blair	Maydl	2	Exstrophy of bladder		Blair				Uremia, 15 mos.	Blair, 1916
	Results: 1 case of exstrophy of bladder. 1 Late death, 100 per cent mortality.										
a(3)	Moskowicz	Maydl	1	Exstrophy of bladder		Moskowicz		Recovered from op.			Moskowicz, 1909
	Results: 1 case of exstrophy of bladder. No death.										
	Spannaus	Extraperitoneal	1	Carcinoma of bladder					Renal obstruction, 7 days		Spannaus, 1911
	Spannaus	Extraperitoneal	2	Carcinoma of bladder			Urinary fistula			6 weeks	Spannaus, 1911
	Results: 2 cases of carcinoma of bladder. 2 deaths (1, surgical, 50 per cent; 1, late, 50 per cent). Total mortality: 100 per cent.										
a(4)	Berg	Maydl	2	Exstrophy of bladder		Berg			Shock		Berg, 1907
	Berg	Maydl	2	Exstrophy of bladder		Berg			Shock		Berg, 1907
	Berg	Maydl	2	Exstrophy of bladder		Berg				2 months	Berg, 1907
	Berg	Maydl	2	Exstrophy of bladder		Berg		Recovered from op.			Berg, 1907
	Results: 4 cases of exstrophy of badder. 3 deaths (2, surgical, 50 per cent; 1, late, 25 per cent). Total mortality: 75 per cent.										
	Berg	Maydl	2	Carcinoma of bladder		Berg		Recovered from op.			Berg, 1907
	Results: 1 case of carcinoma of bladder. No death.										

b	Borelius Berglund	Maydl	1	Exstrophy of bladder	1903	Borelius		Recovered from op.			Borelius, 1903
	Borelius Berglund	Maydl	1	Exstrophy of bladder	1903	Borelius				Renal infection, 3 months	Borelius, 1903
	Borelius Berglund	Maydl	1	Exstrophy of bladder	1915					Pneumonia, 16 years	Lindström, 1932
	Results: 3 cases of exstrophy of bladder. (2 deaths 1, surgical, 33 per cent; 1, late, 33 per cent). Total mortality: 67 per cent.										
	Borelius Berglund	Maydl	1	Carcinoma of bladder	1910	Loewe			Shock		Loewe, 1922
	Results: 1 case of carcinoma of bladder. 1 surgical death. Mortality: 100 per cent.										
	von Misch	Direct	1		1903	von Misch		14 months			von Misch, 1907
	Borelius Berglund		1						Renal infection		Elsberg, 1913
	Results: 2 cases, diagnosis not stated. 1 surgical death. Mortality: 50 per cent.										
c(1)	Müller	Maydl	1	Exstrophy of bladder		Flörcken		5 years			Flörcken, 1922
	Dowden	Maydl		Exstrophy of bladder		Dowden	Renal infection	3 months			Dowden, 1909
	Results: 2 cases of exstrophy of bladder. No deaths.										
c(2)	Muscatello	Maydl and direct	1	Exstrophy of bladder	1904	Muscatello		3 months			Muscatello, 1905
	Muscatello	Maydl	2	Exstrophy of bladder		Moorhead			Peritonitis; pulmonary embolus		Moorhead and Moorhead, 1916
	Results: 2 cases of exstrophy of bladder. 1 surgical death. Mortality: 50 per cent.										
d	Experimental										

TABLE II (concluded)

Method of Operation	Exstrophy			Malignancy		
	Cases	Deaths	Mortality	Cases	Deaths	Mortality
a(2)	1	1	100%			
a(3)	1			2	1	50%
a(4)	4	2	50%	1		
b	3	1	33⅓%	1	1	100%
b (No diagnosis)	2	1	50%			
c(1)	2					
c(2)	2	1	50%			
Total	15	6	40%	4	2	50%

19 cases. 8 deaths. 42 per cent mortality.

c. A blind pouch of the sigmoid emptying into:

(1) *The lower sigmoid*

Müller, in 1903, further modifying the Borelius-Berglund procedure, completely divided the sigmoid, making a blind pouch for the implantation of the trigone (Fig. 2-C). He made a side-to-side anatomosis between the proximal end of the divided sigmoid and the lower sigmoid, and implanted the trigone in the distal end. Müller claimed that this step further insured against the passage of fecal matter into the implanted section and made the anastomosis easier by bringing the intended site near the base of the bladder.

Dowden, in 1908, described a similar technic except that he reunited the sigmoid by a side-to-side anastomosis.

Two patients, operated on by this means, lived (Table II).

(2) *The rectum*

Muscatello, in 1904, devised an exclusion operation in which the sigmoid was divided and the proximal end reimplanted by a side-to-side anastomosis to the rectum. He sutured the trigone into the distal divided end of the sigmoid.

Werelius, in 1911, reported a similar method except that the trigone was implanted in the side of the blind sigmoidal pouch, rather than in the end.

Two clinical cases, in which Muscatello's method was used, yielded a surgical mortality of 50 per cent (Table II).

d. *A blind pouch of the upper rectum*

Utilizing the upper rectum to form a blind pouch, Descomps, in 1909, performed an operation on the cadaver in which he sectioned the upper rectum, closed the inferior end and made a terminolateral implantation of the superior end to the anterior surface of the rectum, low down (Fig. 2-D). The ureters were implanted in the superior portion of the excluded rectum by the principle of mucosa to mucosa and the entire site was extraperitonealized. No clinical cases have been reported.

Clinical Summary.—The surgical principle of the formation of a blind pouch of the intestine into which to implant the ureters has been applied for seventeen patients with seven operative deaths, or a surgical mortality of 41 per cent. The reports of these operations are analyzed in Table II.

Discussion.—The theoretical basis for such operations is unsound, a conclusion which is fully supported by the poor results following the few attempts which have been made to apply it. Rather than serving to protect the ureteral orifices from the fecal current, it seems more logical to suppose that blind pockets act as traps for fecal matter and stasis of urine, thereby contributing to the very danger the surgeon sought to avoid.

Part II. Implantation of the Ureters into the Intact Intestinal Tract

The different methods of implantation into the intact tract are so numerous and the difference between many of them is so slight that in order to get any conception of the relation of methods to results, it is necessary to group them according to the chief principle of surgery upon which they are based. As a rule, articles in the literature refer to a method by the name of the surgeon who originated it. Some minor modification of an original method, however, frequently has attained the status of a new method under the name of the surgeon proposing it, without proper recognition of the underlying principle which he has borrowed. As a consequence, the same surgical principle, for example, the muscularizing and Witzel-gastrostomy method of implantation, carries an American name in the United States (Martin, 1899), a French name in France (Depage and Mayer, 1904), a Russian name in Russia (Tichof, 1905), and an English name in England (Stiles, 1907). Sometimes it is difficult to group together those operations which are similar in principle because of a combination of different principles in the one method of operation. A surgical principle used with the idea of preventing and minimizing a possible complication arising from the intestine should be distinguished from one proposed primarily to prevent a ureteral complication. Placing foremost the principles which have been directed against ureteral complications will simplify the classification of the different operations. The preparation of the bowel, extraperitoneal operations, methods of intra-abdominal drainage, the use of various intestinal clamps and the irrigation of the bowel at the time of operation are all procedures which have been adopted at various times because of the risk of peritonitis. A study of the causes of

peritonitis‡ will show that this complication usually results from leakage after operation because closure at the site of implantation was imperfect, because one or more sutures perforated the bowel or ureter, because one or more sutures tore out at the site of implant, or because a local necrosis of the bowel or ureter occurred by reason of interference with the blood supply. Peritonitis seldom, if ever, results entirely from contamination at the time of operation. Only those principles of surgery, therefore, which are directed against the occurrence of leakage after implantation need be considered. The methods which have been referred to above and which are primarily intended to prevent contamination are of secondary importance, although they cannot be overlooked. The preparation of the bowel by the use of a non-residue diet and enemata beforehand is the only practical and essential procedure. The methods which are used to prevent postoperative leakage at the site of implantation are related closely to the surgical principles directed against the occurrence of ureteral complications (obstruction—infection). It is a question, for instance, whether the submucosal method of implantation should be regarded in principle as a surgical imitation of the ureterovesical valve, as was proposed by Coffey, or as a simple and sound way to prevent leakage as well as the only natural route for the entrance of the ureter into the bowel.

With these limitations and exceptions, eleven surgical principles of uretero-intestinal implantation can be recognized. In order to give their full historical value they will be discussed in the order in which they have been proposed, and insofar as it is possible, the originator of the principle will be indicated. Some of the original contributions are purely experimental and the idea has been applied later, clinically, by another surgeon, often in a modified form. An attempt has been made to distinguish between the experimental and the clinical and to indicate the major modifications of each original principle.

We recognize the possibility of error in our interpretation of originality. The literature available to us is incomplete. The main purpose of this study, however, is not historical.

The eleven surgical principles which have been applied to ureterointestinal implantation may be classified chronologically as follows:

‡Hinman, Frank, et al: An experimental study of uertero-intestinal implantation: I. The cause of peritonitis. Surg., Gyn. and Obst., 62:909-917, 1936.

1. The formation of a fistulous tract (1851)
2. The direct anastomosis of ureter and bowel (1878)
3. The muscularizing principle
   (a) To prevent leakage (1886)
   (b) Stripping action (1899)
4. The preservation of the ureterovesical orifice (1892)
5. The temporary diversion of urine until healing has occurred (1892)
6. The use of a flap to act as a valve (1895)
7. The use of mechanical devices (1895)
8. Implantation into structures which open normally into the gastro-intestinal tract (1900)
9. The submucosal principle (valve action) (1910)
10. Temporary colostomy (1915)
11. The use of the intact ureter (1931)

These surgical principles will be discussed, and the operative cases which have been reported will be analyzed, in this chronological order.

THE FIRST SURGICAL PRINCIPLE

The formation of a fistulous tract between the ureter and the bowel.

a. In cases of exstrophy by a long suture connecting the lumen of the ureter to the lumen of the bowel.
   Simon (July, 1851),
   Lloyd (October, 1851).

b. By a submucosal tunnel in the intestinal wall.
   (Kirwin, 1930, experimental).

c. By the transfixion suture,
   1. With submucosal implantation. Ninth surgical principle (Coffey, No. 3, 1930).
   2. With the intact ureter. Eleventh surgical principle (Higgins, 1933).
   3. With temporary drainage by ureterostomy. Fifth surgical principle (Hinman, 1935).

d. By perforation of apposing surfaces with the cautery, in conjunction with the use of the intact ureter. Eleventh surgical principle.
   (Ferguson, 1931, experimental.)
   (Poth, 1935, experimental.)

e. By the electric coagulation of apposing surfaces without perforation. Experimental.
   (Wadhams and Carabba, 1935.)

f. By the transfixing hair pin method in conjunction with the intact ureter (eleventh principle).
(Brenizer, 1935.)

a. *Forming a long fistulous tract by use of a suture (Simon).*— The earliest attempt to divert the urine from the ureter to the large bowel was made by establishing a long fistulous tract between these two structures. On July 5, 1851, in a case of exstrophy of the urinary bladder, Sir John Simon passed two sutures through each ureter into the rectum (Fig. 3-A). The rectal ends were

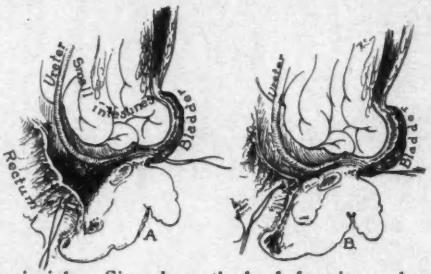

Fig. 3. First principle. Simon's method of forming a long fistulous tract between ureter and bowel.
A. Two parallel sutures passing from ureter into rectum. *B.* Rectal ends of sutures tied, traction applied to vesical ends. (After Pousson.)

united on either side and fistulæ produced by pressure necrosis by means of the application of continual traction to the ureteral ends of the suture (Fig. 3-B). Although the patient passed large quantities of urine by rectum within three weeks' time, all attempts at closure of the ureterovesical orifices failed and death ensued in twelve months from pelvic peritonitis and "kidney and ureteral disease." At necropsy, both ureters were found to be blocked by calculi although the fistulæ were still patent.

In October of the same year, Lloyd employed this principle in performing an operation upon another patient with exstrophy. The patient succumbed in seven days to a generalized peritonitis which was caused by perforation of the peritoneal cavity by the ureterorectal transfixion sutures.

The failure of these initial operations branded the principle of the formation of a long fistulous tract as dangerous and impractical and it was not until seventy-nine years later that the principle was revived in modified forms.

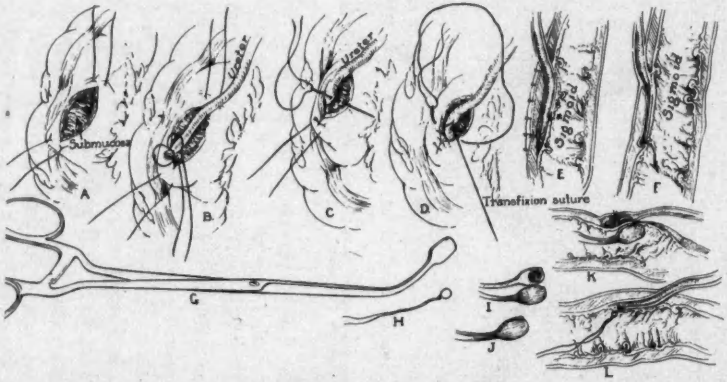

Fig. 4. First and Ninth Principles. Forming a fistulous opening between the submucosally implanted ureter and the lumen of the bowel by a transfixion suture. (Coffey's technic No. 3.)

A. Incision in the sigmoid down to the submucosa. *B.* The end of the ureter transfixed and ligated with a suture anchoring it between the submucosa and muscularis at the lower angle of the incision in the bowel. *C.* Transfixion suture passing through the lumen of the ureter and the lumen of the bowel. *D.* Suture of the muscularis and serosa over the submucosal course of the ureter. *E.* Sectional view of the transfixion operation. The star shows the transfixion suture. *F.* The final result showing the fistula from the ureter into the bowel.

Figures *G* to *L* illustrate the modification with the use of the metal rings. *G.* Special rectal forceps for introducing the metal ring. *H.* Metal ring with linen thread attached. *I.* Forceps open, about to grasp the metal ring and attached thread. *J.* Forceps grasping the metal ring. *K.* Transfixion suture passed through the metal ring held in place by forceps. *L.* Forceps removed, transfixion suture tied through the metal ring bearing the thread which passes out the anus. (After Coffey.)

b. *By the submucosal tunnel in the intestinal wall.*—In 1930, Kirwin described an experimental method by which a fistulous tract was formed in the wall of the intestine between the submucosa and muscularis with the idea of minimizing ascending infection by the formation of a valve and by separating the end of the ureter from the fecal current. A ureteral catheter led from the end of the ureter and was transplanted intramurally through the artificial canal in the wall of the bowel and out to the rectum for the drainage of urine, until the new canal could be used. As a measure intended to avoid stenosis, a silk buttonhole suture was whipped around the orifice in the submucosa.

c. *By the transfixion suture.*—

(1) *With submucosal implantation.*—Coffey, also, in 1930, with the idea of diminishing sepsis, proposed the use of a transfixion suture in conjunction with submucosal implantation (Fig. 4). The uretero-intestinal orifices are formed by the sloughing through of sutures which transfix the lumina of the ureters to those of the bowel. As the urinary stream is blocked until this occurs, the ureters must be implanted in two stages, one at a time.

Acting upon a suggestion made by Walker-Taylor, Coffey, in 1932, modified the operation by placing in the rectum a metal ring to which the transfixion suture is anchored (Fig. 4-H and L). This assures a penetration of the intestinal lumen and makes more certain and rapid, a cutting through of the suture by means of traction on a string tied to the ring and leading through the anus. This modification was especially devised to prevent failure in the establishment of fistulæ when dealing with thickened ureters, as actually had happened.

Too few cases by the submucosal method with the transfixion suture (technic No. 3 of Coffey) have been reported to permit any worthwhile conclusions concerning the clinical results following its application. In eight cases, five of exstrophy and three in which the diagnosis was not stated, there were no deaths. In three cases of malignancy there were two surgical deaths, one from pneumonia and the other from urinary infection. The third patient survived the operation but died eight months later from a recurrence of a carcinoma of the cervix.

(2) *With the intact ureter.*—Higgins (1933) also utilized Cof-

fey's transfixion suture, devising a two-stage operation which deferred diversion of the urinary stream from its normal course into the bladder until after the fistulous tracts were established. This operation is described under the eleventh surgical principle, the use of the intact ureter.

(3) *With drainage by ureterostomy.*—In order to make possible a bilateral one-stage operation by the submucosal method with a transfixion suture, Hinman, in 1933, proposed an extraperitoneal ureterostomy for the purpose of draining the urine by extraperitoneal catheter (see Fifth Surgical Principle) until such time as the suture cut through to establish a new orifice.

d. *By perforation of apposing surfaces with a cautery.*—This method has been used experimentally by Ferguson and Poth in conjunction with the surgical principle of the intact ureter and will be discussed in that connection.

e. *By coagulation without perforation of the apposing surfaces.*—A method of forming a fistula between the ureter and bowel other than by a transfixion suture or perforation has been suggested by Wadhams and Carabba (1935). These writers obtained an apparently satisfactory communication in one dog by electric coagulation of small apposing areas of the intestinal submucosa and ureteral wall. Following coagulation of the surfaces to be placed in apposition, the ureter is implanted submucosally so that these coagulated surfaces are apposed, being held in place by sutures which do not penetrate either the lumen of the ureter or that of the rectum. In their one experimental case the operation was performed in two stages, the right ureter being implanted one week after the left. At the second operation the left kidney was found to be dilated but had almost returned to normal size when the animal was sacrificed two weeks after the second implantation. At this time, however, the right kidney was dilated and pus was present in the contained urine.

f. *By loop and transfixion wires in conjunction with the use of the intact ureter.*—This technic of formation of a fistulous tract is discussed in connection with the eleventh principle.

Summary of Cases.—The sixteen operations which have been reported as having been performed by the methods listed under

TABLE III. THE FORMATION OF A FISTULOUS TRACT BETWEEN THE URETER AND THE BOWEL

The First Surgical Principle

a. By suture from ureter to rectum (Simon).
c1. By transfixion suture in imbedded ureter—unilateral (two-stage) Coffey No. 3.
c3. By transfixion suture with extraperitoneal ureterostomy drainage by ureteral catheter—bilateral (one-stage) (Hinman).

Condition		I. Congenital Anomalies and Trauma			II. Vesical Infection (Ulcer)			III. Malignancy			IV. Not Stated			Total		
		a	c1	c3	a	c1	c3	a	c1	c3	a	c1	c3	a	c1	c3
Number of Cases		2	5				1		3	2		3		2	11	3
Deaths: Surgical	S	1							2	1				1	2	1
Late	L	1							1	1				1	1	1
Causes: Shock	S															
	L															
Pneumonia	S								1						1	
	L															
Urinary Infections	S								1	0.5					1	0.5
	L															
Urinary Obstruction	S									0.5						0.5
	L	1												1		
Peritonitis	S	1												1		
	L															
Bowel Obstruction	S															
	L															
Recurrence								(8 la	1 mo ter)	1 s.)					1	1
Not Stated	S															
	L															
Total Deaths		2							3	2				2	3	2

Summary: 16 cases, 7 deaths

a; c, 1 and c, 3, are analyzed in Table III (two by method a; eleven by method c, 1 [Coffey No. 3], and three by method c, 3). The operative mortality was 25 per cent.

Discussion.—Simon's method of forming a long, fistulous tract is unsurgical. In exstrophy of the urinary bladder, the only condition suitable for the employment of this technic, the peritoneum extends extremely low, almost reaching to the anus. The likelihood of perforating the peritoneum, therefore, is very great. Even granting that one might avoid the peritoneum, there still remains the apparently insurmountable difficulty of closing off the ureteral orifices. Furthermore, no provision is made for epithelialization of the long fistulous tract. Without an epithelial lining, urinary extravasation, the spread of infection into the surrounding tissues, or the ultimate constriction or closure of the sinus is inevitable.

Kirwin recognized the deficiency of his method of forming a fistulous submucosal tunnel in the intestinal wall when, in 1934, he stated that the operation was unsatisfactory because the artificial canal failed to epithelialize and eventually a stricture formed at the site of implantation, which favored, rather than retarded, ascending infection.

Coffey's technic No. 3, utilizing a transfixion suture in conjunction with the submucosal principle, has the advantage of not requiring an open incision into the bowel. It has, however, these disadvantages: (1) the transfixion suture contaminates the operative field; (2) the ureter is obstructed until a fistulous tract is formed, and (3) the fistulous orifice, which is formed when the suture finally sloughs through, is a lateral slit in the uretheral wall, an opening never so permanently patent as an orifice at the end.

This last objection would seem to be the chief drawback to the formation of a uretero-intestinal orifice by electric perforation or coagulation. Either method produces a side opening in the ureter which tends to become constricted because of the very nature of a longitudinal opening in the wall of a muscular channel.

The one advantage of the electric coagulation method of Wadhams and Carabba is that of being aseptic. Unfortunately, the procedure entails the technical difficulty of producing, uniformly, that degree of coagulation which will assure the development of a satisfactory fistula without perforation into the peritoneal cavity.

Temporary interruption of the urinary stream is a further disadvantage and there is also the possibility that a fistula may fail to develop on account of insufficient coagulation.

THE SECOND SURGICAL PRINCIPLE

The Direct Anastomosis of the Ureter and Bowel

a. The direct anastomosis of mucosa to mucosa.
   1. Using the end of the ureter (end to side).
      (Smith, 1878; Chaput, 1892.)
   2. Suturing a slit in the side of the ureter to a slit in the side of the bowel (side to side).
      (Peterson, 1900.) Experimental.

b. Axial implantation of the ureter without the suture of mucosa to mucosa.

Fig. 5. Second Principle. The direct anastomosis of the end of the ureter to the side of the bowel suturing mucosa to mucosa by the method of Smith and Chaput.

A. The ureter is brought to the elected site for implantation into the bowel. *B*. An opening is made into the lumen of the bowel and sutures are laid which will unite mucosa to mucosa. *C*. The anastomosis is completed, interrupted sutures closing the muscular and serous layers of the bowel around the ureter (étagenaht). (After Papin.)

a. *The Direct Anastomosis of Mucosa to Mucosa.*

1. *Using the end of the ureter.*—The first actual transplantation of the ureters into the bowel in man was carried out by T. Smith, in 1878. The method, original with Smith but generally attributed to Chaput (1892), consists of a direct axial transplantation of the end of the ureter into an opening made through all coats of the intestine (Fig. 5). The mucosa of the ureter is sutured to the mucosa of the bowel and another line of sutures closes the muscular and serous layers of the bowel around the ureter.

2. *Suturing a Slit in the Side of the Ureter to a Slit in the Side of the Bowel.*—Although Boari, in 1895, devised a lateral anastomosis with his mechanical button, it was not until 1900 that

Peterson described a lateral anastomosis of the ureter to the bowel by means of suture (Fig. 6). Employing a technic similar to the end-to-side operation, he united a slit in the side of the ureter to an opening in the intestine, in dogs. His attempt, by this method, to avoid dilatation of the ureters and ascending infection met with no success. The operation has not been performed clinically.

b. *Axial Implantation of Ureter Without Suture of Mucosa to Mucosa.*—Glück and Zeller, in 1881, in the first experimental work on dogs, used an axial method without the suture of mucosa to mucosa. In 1898, Frank sutured the ureters side by side into one

Fig. 6. Second Principle. Peterson's side-to-side anastomosis of the ureter to the bowel by suture of mucosa to mucosa.

A. The course of the ureter over the sigmoid showing the opening (in outline) which will be made between the two structures. *B.* Sectional view of the sutures joining mucosa to mucosa.

rectal incision by the direct method. He introduced the use of an anchoring suture to fix the end of the ureter. Frank's suture, however, only penetrated the mucosa and muscularis, being closed over by serosa, instead of perforating it as in the anchoring suture of some of the later methods. This technic was designed to prevent leakage of the bowel contents along the suture into the peritoneal cavity.

Beaver and Mann, in 1932, attempting various technics, reported the best results by a simple, direct implant, in experiments on dogs (Fig. 7).

Summary of Cases.—Of thirty-seven patients undergoing axial transplantation, sixteen died during the stay in the hospital, a surgical mortality of 43 per cent (Table IV). In seventeen of these patients, suffering from congenital malformations, only four deaths

were reported, while in fifteen cases of malignancy, there were eleven deaths. There was no particular preponderance of any one cause of death. Of postoperative complications, renal infection occurred in eight cases (21.6 per cent), urinary obstruction and the formation of a fistula each in five (13.5 per cent) and peritonitis, intestinal obstruction and infection of the wound in two cases each (5.4 per cent).

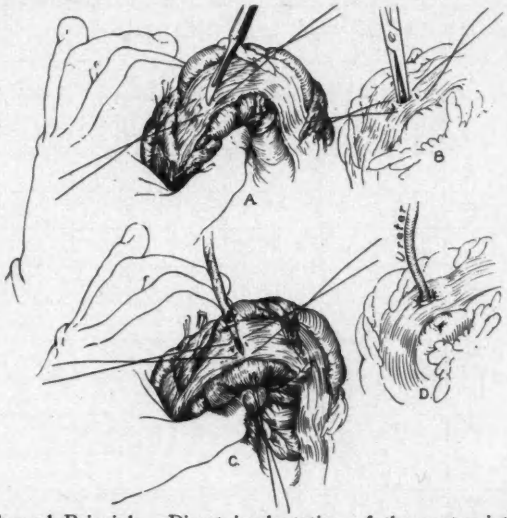

Fig. 7. Second Principle. Direct implantation of the ureter into the bowel by the method of Beaver and Mann without suture of mucosa to mucosa.

A. Stab wound being made through all layers of the sigmoid between stay sutures. *B.* Enlarging the opening with a clamp. *C.* An anchoring suture, after transfixing either side of the end of the split ureter, is introduced into the lumen of the bowel and out through all layers. *D.* The end of the ureter is drawn into the lumen of the bowel and fixed in place by tying the anchoring suture. The incision in the sigmoid is repaired around the ureter. (After Beaver and Mann.)

Discussion.—The disadvantages of the direct method of implantation are obvious. Accurate approximation of mucosa to mucosa is difficult and cannot be done without gross contamination from the intestinal tract. Considerable edema results from the sutures, causing a more or less temporary interruption of the urinary stream. Later, with healing, the infection which is inevitably present produces stenosis of the orifice and urinary obstruction. The gravest danger, however, is of peritonitis from postoperative leak-

TABLE IV. THE DIRECT ANASTOMOSIS OF URETER AND BOWEL. END-TO-SIDE. (SMITH, CHAPUT)
The Second Surgical Principle

Condition		I. Congenital Anomalies and Trauma	II. Vesical Infection (Ulcer)	III. Malignancy	IV. Not Stated	Total
Number of Cases		17	3	15	2	37
Deaths: Surgical	S	3	2	9	2	16
Late	L	1	1	2		4
Causes: Shock	S			2		
	L					
Pneumonia	S			1		
	L					
Urinary Infections	S	1		1.5	1	
	L			1.5		
Urinary Obstruction	S		2	1		
	L	1	1			
Peritonitis	S	1		1.5		
	L					
Bowel Obstruction	S	1				
	L			0.5		
Not Stated	S			1	1	
	L			1		
Total Deaths		4	3	11	2	20

Summary: 37 cases, 20 deaths

age at the site of implantation because of the short, direct course of the ureter through the wall of the intestine without provision for sealing off by some form of overlapping.

The objection to the direct method, frequently raised, that the absence of a valve-like mechanism favors a reflux of fecal contents directly up the ureter, does not seem logical. The advantage

of an oblique insertion may lie rather in the diminution of the danger of leakage around the ureter than in the prevention, by valvular action, of reflux up the lumen. The good results achieved in the experiments of Beaver and Mann would tend to disprove the need for a valve. The lip of the orifice of a normal ureter is mucosal, devoid of muscle and acts as a valve in consequence. The uretero-intestinal orifice of a transplanted ureter retains the muscular coats of the ureter and does not have the same valvular action as the ureterovesical entrance, regardless of an oblique insertion.

Peterson's lateral anastomosis is subject to all of the foregoing objections as well as to the drawbacks of an orifice on the side, which were taken up under the first surgical principle.

THE THIRD SURGICAL PRINCIPLE

The Muscularizing Principle

a. Overlapping of the intestinal wall to form a muscular canal around the ureter (as around Witzel's gastrostomy tube, 1891). (Bardenheuer, experimental, 1886, clinical, 1887; Depage and Mayer, 1904; Tichoff, 1905; Stiles, 1907.)

b. A muscular canal around the ureter beneath the serosa (stripping action). (Martin, 1899.)

c. With preservation of the ureteral orifice. The fourth principle. (Jefferson, 1908.)

a. Overlapping of Intestinal Wall.—One of the favorite principles employed in uretero-intestinal anastomosis has been an implantation of the ureter in a canal made by overlapping the bowel wall, similar to the method carried out by Witzel, in 1891, in his classic operation for forming a canal of stomach wall around a gastrostomy tube.

Bardenheuer was the first surgeon to utilize the principle in ureteral surgery when, in 1886, he implanted single ureters extraperitoneally in five dogs. Two died of an unknown cause, two showed stenosis at the site of transplantation when sacrificed after four weeks and the other a pyonephrosis when killed at the end of a year. In 1887, before performing the first cystectomy in man, Bardenheuer implanted both ureters into the rectum. The patient died some time later in uremia arising from a bilateral hydronephrosis.

The method used by Bardenheuer was original. He tied the ureter over a curved needle which was thrust through the wall into the lumen of the colon and brought out one-half inch below the point of entrance, carrying the ureter in and out along with the needle. The end of the ureter, which presented at the lower perforation, was detached from the needle and allowed to slip back

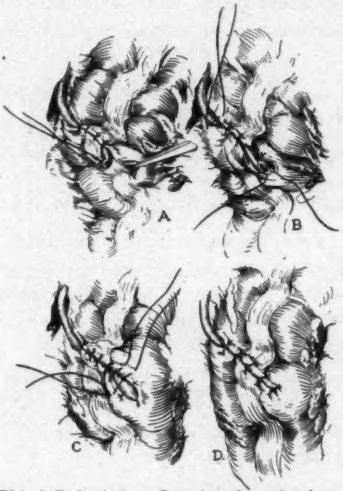

Fig. 8. Third Principle. Overlapping the intestinal wall to form a muscular canal around the ureter by the method of Tichoff-Mirotworzeff.

A. The ureter is enclosed in a serosal muscular channel of the wall of the bowel formed by sutures which include the adventitia of the ureter. Window being made in gut wall. *B*. The end of the ureter being sutured in the window made into the lumen of the gut. *C*. Anastomosis between the end of the ureter and the wall of the gut completed; final sutures of the serosal muscular canal being laid. *D*. The completed operation. (After Mirotworzeff.)

through this perforation into the lumen of the gut, the opening then being closed by a suture. The bowel was invaginated at the site of the entrance of the ureter so as to form a muscular channel about the ureter.

In 1892, Morestin, using six dogs, implanted the ureter through a buttonhole in the rectum, whipping the intestine over the ureter with a continuous suture. All died of peritonitis or ascending renal infection.

In 1904, Depage and Mayer applied Depage's method of ureterocystoneostomy to a bowel-implantation in one patient, with recovery. The method consists in introducing the obliquely cut end of the ureter for a distance of 15 mm. into the bowel and fixing it with an anchoring suture. The ureter is then enclosed in a serosal tunnel with a continuous silk suture.

In 1905, Tichoff, after numerous experiments on the transplan-

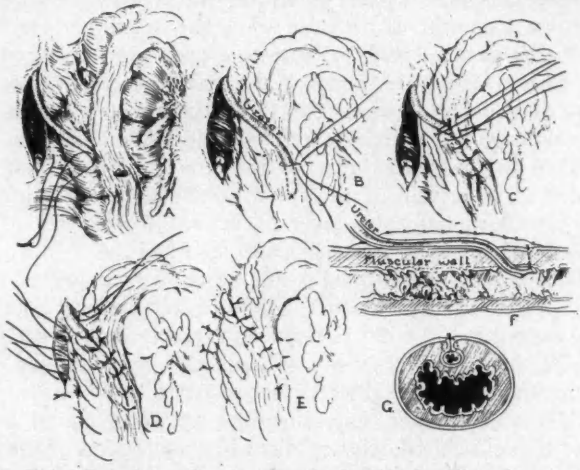

Fig. 9. Third Principle. Overlapping the intestinal wall to form a muscular canal around the ureter by the method of Stiles.

A. The ureter is divided, an anchoring suture placed in the end and an incision made into the lumen of the bowel. *B*. The ureter is drawn into the lumen of the sigmoid by the anchoring suture which is tied outside the bowel after transfixing all layers; sutures laid for closing the opening in the sigmoid. *C*. Interrupted sutures through the adventitia of the ureter and serosa and muscularis of the bowel forming a muscular canal around the ureter. *D*. Sutures closing the peritoneum over the bed from which the ureter was taken. *E*. Transplantation completed. *F*. Sectional view showing the course of the ureter in the muscular canal. *G*. Cross section of the ureter in the muscular canal. (After Turner and Walker-Taylor.)

tation of the ureter to the intestine, developed a technic utilizing the Witzel gastrostomy procedure. The ureter was first enclosed in a serosal muscular channel, fashioned from the rectal wall by a line of interrupted sutures which included the adventitia of the ureter. A small tongue-shaped opening made into the bowel, served for introducing the end of the ureter which was buried by reuniting the edges of this incision. The site of implantation was finally reinforced with pelvic peritoneum.

Mirotworzeff, in 1909, modified Tichoff's method by suturing the

end of the ureter into the window made in the bowel (Fig. 8). He reported six unilateral transplants in dogs and six bilateral implants in human beings with only one surgical death in each series.

In 1907, Stiles also applied the muscularizing principle, differing from Tichoff in his technic, however, in that he anchored the end of the ureter in the bowel before laying the sutures for the canal of intestinal wall (Fig. 9). The anchoring suture placed through the adventitia of the ureter penetrated all layers of the intestine, coming out a quarter of an inch below the opening. He brought together two parallel folds of intestine over the implanted ureter with a fine linen suture, starting the folding-over process three-quarters of an inch below the entrance of the ureter into the bowel and continuing it for a distance of one inch above it. Bites were taken in the outer layer of the ureter without penetrating the lumen. If the wall of the colon were sufficiently thick, Stiles advised an additional outer layer of interrupted sutures. Tichoff and Stiles both used the intraperitoneal approach.

In 1909, Knaggs performed a unilateral Witzel type of anastomosis in a case of vesicovaginal fistula, using a sacral route. He resected the coccyx in order to make an extraperitoneal rectal transplant. The opposite kidney was subsequently removed and the patient was reported well eighteen years thereafter.

In 1910, von Rihmer, experimenting on dogs, found that the muscular tunnel method often resulted in compression of the ureter.

b. Formation of a Muscular Canal (Stripping Action).—Martin, in 1899, after extensive studies on dogs, presented his muscularizing principle which differed from the Witzel gastrostomy technic in that the muscular canal was made beneath the serosa (Fig. 10). He buried the ureters, side by side, longitudinally in the walls of the rectum for a distance of an inch or more, so that they could be milked downward by the contraction of the muscles of the bowel artificially surrounding the ureters. One inch below their point of entrance the ureters were anchored into the lumen of the bowel to the fibrous and muscular coats of the bowel by a suture penetrating the adventitia of the ureter. The ureters were closed over by rolling them into the muscular coats and fastening them by silk sutures, care being taken to avoid constriction.

c. With Preservation of the Ureteral Orifice.—Jefferson, in 1918, combined the muscularizing principle with Bergenhem's op-

eration, preserving a rosette of mucous membrane surrounding the ureteral orifice (the Fourth Surgical Principle). He drew the end of the ureter through a very small opening in the bowel with a traction suture which he removed subsequently. He attributed the avoidance of ascending infection, in one patient who recovered, to the preservation of the ureteral orifice.

Summary of Cases.—The results which have been obtained by the use of this principle are shown in Table V. In 136 cases, there

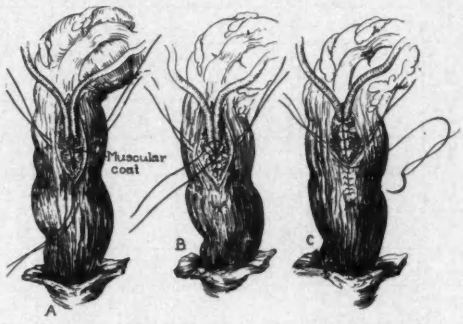

Fig. 10. Third Principle. The formation of a muscular canal around the ureter beneath the serosa by the method of Martin.

A. The ureters are divided and placed side by side on the denuded muscular coat made by an incision through the serosa; an anchoring suture, placed through the ends of both ureters, enters the opening made into the bowel lumen in the distal area of the reflected serosa and transfixes the entire wall one inch farther on. *B*. The anchoring suture is tied and the ureters are closed over by muscularis with interrupted sutures. *C*. Closure of the serosal layer. (After Coffey.)

were thirty-eight operative deaths, a mortality of 28 per cent. Renal infection made its appearance in forty-nine cases (36 per cent), the only other frequent complication being peritonitis, which occurred in twenty-two cases (16.2 per cent).

Discussion.—The oblique insertion of the ureter, first used in the methods grouped under the muscularizing principle, has, theoretically, the advantage of allowing a secure closure to be made with less likelihood of leakage after operation and therefore with a diminution in the risk of peritonitis. In practice, however, this was not true (peritonitis caused death in 16.2 per cent).

The claim of milking of the ureters by intestinal peristalsis and of valvular occlusion during distention of the bowel because of the muscular canal does not seem tenable.

TABLE V. THE MUSCULARIZING PRINCIPLE (STRIPPING ACTION)

The Third Surgical Principle

Condition		I. Congenital Anomalies and Trauma	II. Vesical Infection (Ulcer)	III. Malignancy	IV. Not Stated	Total
Number of Cases		89	3	44		136
Deaths: Surgical	S	17	1	20		38
Late	L	4	1	5		10
Causes: Shock	S			2		
	L					
Pneumonia	S			2		
	L	1				
Urinary Infections	S	7.5	1	6		
	L	0.5	1	1		
Urinary Obstruction	S			1		
	L	1				
Peritonitis	S	7.5		7		
	L	0.5		1		
Bowel Obstruction	S			1		
	L					
Not Stated	S	1		1		
	L	2		3		
Total Deaths		21	2	25		48

Summary: 136 cases, 48 deaths

The inherent defects of the method are: ureteral compression because of overlapping of the musculature of the large intestine when sutured in one or more layers about the ureter, necrosis of the bowel by interference with the blood supply because of the overlapping, perforation of the gut by one or more sutures, and tearing out of the sutures which do not catch the submucosa. Any of

these complications might lead to the formation of a fistula and peritonitis.

THE FOURTH SURGICAL PRINCIPLE

The Preservation of the Ureterovesical Orifice

a. By transplantation of the trigone with both orifices intact. (Maydl, 1892; Moynihan, 1905.)

b. By transplantation of each orifice separately in the form of a rosette. (Bergenhem, 1894; Jaja, 1901.)

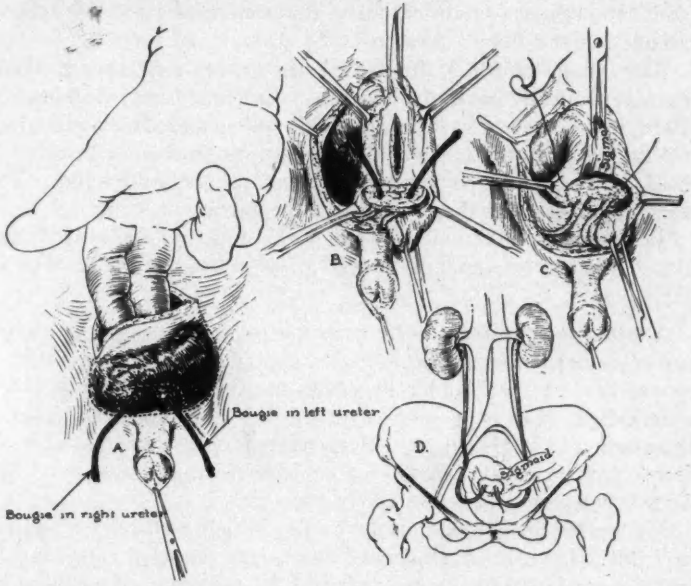

Fig. 11. Fourth Principle. Maydl's intraperitoneal method of implanting the trigone with the ureteral orifices intact into the sigmoid.

A. Bougies inserted up the ureters; the lines of incision for preserving the ellipse of the vesical mucous membrane surrounding the ureteral orifices and for resecting the remainder of the exstrophied bladder. *B.* Longitudinal incision through all layers of the sigmoid for reception of the freed ellipse of the trigone. *C.* The trigone inserted in the sigmoidal incision and sutured in place. *D.* The completed operation. (After Katz and Edmonds.)

a. The Method of Maydl.—Maydl was the first to apply the principle of preserving the ureterovesical orifice in order to prevent ascending urinary infection (suggested by Tuffier in 1888). In 1892 he transplanted, by the intraperitoneal route, the base of the inverted bladder into the large bowel (Fig. 11). A small ellipse of

trigone bearing the ureters was introduced into a longitudinal incision in the sigmoid and the adjacent mucous membranes of the bladder and intestine were united by interrupted sutures. The anastomosis was completed by a similar line of sutures joining the muscular and serosal coats of the wall of the bowel to the muscular layers of the wall of the bladder.

In 1897 Maydl introduced the use of flaps to reinforce the line of suture. One year later he extraperitonealized the operation in order to prevent contamination of the peritoneal cavity by urine and feces, should a fistula develop.

Moynihan, in 1905, implanted the entire exstrophied bladder extraperitoneally into the rectum. Coleman and Wilkinson, in 1918, in a further development of Moynihan's modification, sutured off the peritoneum as high above the anastomosis as possible and used the redundant peritoneum to reinforce the suture line. Their aim was to prevent the formation of a hernia.

Peterson, in 1900, and Beck, in 1906, applying the Maydl operation, sutured rectangular (instead of elliptical) trigonal flaps into the sigmoid.

Summary of Cases.—The principle of preserving the ureteral orifice is limited in application to cases of exstrophy or other abnormalities of the bladder in which the trigonal region is not involved in a disease process. Out of 243 cases collected from the literature (178, Maydl; 65, Bergenhem) only three patients suffered from vesical infection and four from malignancy. The diagnosis was not stated in thirty-one cases.

The results in 178 operations by the Maydl method are analyzed in Table VI. Fifty-five surgical deaths are reported following 178 trigonal implantations, a mortality of 31 per cent. Ascending urinary infection accounts for the greatest number of deaths, twenty-three, with peritonitis ranking second, accounting for 9.5 per cent.

Renal infection was present as the usual predominant complication in forty-three patients, making an incidence of 24.2 per cent. Fistulæ were reported in seventeen, or 9.6 per cent of the cases.

Peritonitis, which occurred in twenty-four cases, or 12.5 per cent, is to be explained by the frequency of leakage along the line of anastomosis.

Discussion.—Infection, followed by the formation of an abscess and the breaking down of sutures, is likely to occur in a long line

of sutures which is contaminated when being laid, no matter how firm is the immediate union. This factor constitutes one of the outstanding defects of the Maydl operation. The extraperitoneal modifications, while not reducing the occurrence of fistulæ, contribute to the safety of the procedure by the prevention of peritonitis.

Another detrimental feature which is peculiar to the Maydl type of operation is the curved course which the lower parts of the ureters are required to take in order to reach the transposed position of the trigone. Unless extreme care is exercised in selecting the proper site for anastomosis, tension may result in kinking of the ureters with the development of urinary obstruction.

Technical difficulty is encountered in carrying out the operation in women because of the presence of the female pelvic organs. In some cases the difficulty is so great that the necessity of performing a hysterectomy is added to an already extensive operative procedure.

b. The Method of Bergenhem.—Although numerous surgeons have assumed credit for originating the method of separate extraperitoneal transplantation of the intact ureteral orifices, the first authentic report was published by Bergenhem, in 1894, and to him priority is now universally conceded.

Jaja of Italy, who claims to have antedated Bergenhem by several months, did not publish his article until 1901. His description of the operation is hazy. The method was used in succession by Trendelenburg of Germany (1895), Pozza of Italy (1897), Martin of the United States (1898), Capello of Italy (1898), Lendon of Australia (May 12, 1899) and Peters of Canada (July 5, 1899). Lendon and Peters, to each of whom the method frequently has been attributed, furthered its popularization.

The operation consists of dissecting out the vesical ends of the ureters with a rosette of vesical mucosa about 1 cm. in diameter (Fig. 12). Then, with the aid of ureteral catheters which are removed at the completion of the operation, the ends of the ureters are introduced, extraperitoneally, into small perforations made in the rectum. The ureters project into the rectal lumen for a short distance, where they may be fixed in place with sutures to the rectal mucosa (Bergenhem, Pozza) or anal skin (Buchanan), or by forceps (Lendon). Some surgeons, on the other hand, depend

upon the nubbin of vesical mucosa to prevent the escape of the ureters, and allow the ends to hang free (Trendelenburg, Peters).

The use of ureteral retention catheters following the Bergenhem operation was recommended by Peters and later by Huguier (1910) and Feutrie (1911).

Helferich (1900) combined the procedures of Maydl and Bergenhem by intraperitoneal transplantation of the separated ureters,

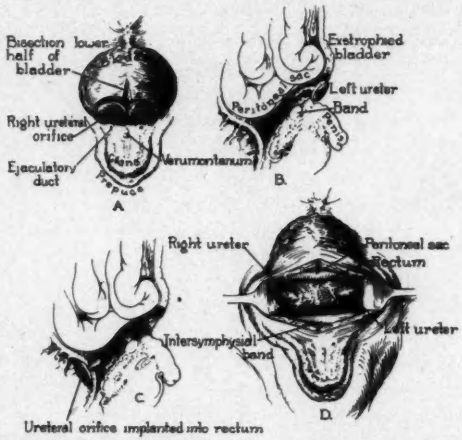

Fig. 12. Fourth Principle. Bergenhem's method of extraperitoneal implantation of intact ureterovesical orifice with surrounding rosette of vesical mucous membrane.

A. Bisection of the lower half of the exstrophied bladder and incision freeing rosettes around each ureteral orifice. *B.* Sectional view showing the ureter freed extraperitoneally. *C.* The ureter inserted into a slit in the rectum. *D.* The transplanted ureters in place, the rectum exposed, intersymphysial band below, peritoneum above. (After Hutchins and Hutchins.)

with orifices intact, into one rectal incision. Jacobson (1903) in a similar combination of methods used the extraperitoneal route.

Summary of Cases.—The results with the Bergenhem procedure are analyzed in Table VI with those of Maydl's operation. The reports of sixty-five cases by the Bergenhem procedure have been published, with eleven surgical deaths, giving a mortality of 17 per cent.

Discussion.—In this operation, as well as in Maydl's, the factor of leakage at the site of the anastomosis is the greatest drawback. Fistulæ occurred in fourteen cases, or 21.5 per cent. Instead of

TABLE VI. PRESERVATION OF THE URETEROVESICAL ORIFICE

The Fourth Surgical Principle

a. Transplanting the Trigone with Both Orifices Intact (Maydl)
b. Transplanting Each Orifice Separately in the Form of a Rosette (Bergenhem)

Condition		I. Congenital Anomalies and Trauma		II. Vesical Infection (Ulcer)		III. Malignancy		IV. Not Stated		Total	
		a	b	a	b	a	b	a	b	a	b
Number of Cases		150	55	1	2	2	2	25	6	178	65
Deaths: Surgical	S	41	7			1		13	4	55	11
Late	L	8	9		1		1	1		9	11
Causes: Shock	S	6	2					1			
	L										
Pneumonia	S	1.5						1			
	L	1.5	1								
Urinary Infections	S	16	1			1		3			
	L	3	4.5		1						
Urinary Obstruction	S	5							1		
	L	1.5	1.5					1			
Peritonitis	S	8.5	1					1	2		
	L										
Bowel Obstruction	S	1									
	L										
Not Stated	S	3	3					7	1		
	L	2	2				1				
Total Deaths		49	16		1	1	1	14	4	64	22

Summary: 243 cases, 86 deaths

a defect incident to suture, however, leakage in this instance is caused by an imperfect juncture of the ureter with the bowel. Being in the nature of a direct transplant (the second surgical principle), the method is open to the same objections. On a few occa-

sions the ureter has escaped from the bowel. This complication may occur when there has been damage to the blood supply of the lower part of the ureter sufficient to cause necrosis or when too large an opening is made in the rectal wall, permitting the ureter to work out by means of its own peristaltic action or that of the intestine, or by movements of the patient.

The danger of peritonitis is minimized by the extraperitoneal approach. This is amply proved by the presence of peritonitis in only three cases, or 4.6 per cent.

The preservation of the ureterovesical orifice has not removed or noticeably lessened that complication which it was originally designed to avoid—ascending urinary infection. Although the ureterovesical orifice is left intact, the divided portion of the vesical wall surrounding the trigone or rosette still opens the lymphatics, blood vessels and tissue spaces to fecal contamination from the rectum. In view of the septic nature of the anastomosis even the coaptation of mucosa to mucosa in the Maydl procedure cannot satisfactorily wall off these avenues of the spread of infection. Contrary to an often presented viewpoint, preserving the ureterovesical orifice does not maintain the normal valve-like action which is present within the bladder. Robbed of its supporting stroma and autonomic nerve supply, the entrance at once becomes nothing more than a flimsy orifice which can boast no distinct advantage over the divided end of a ureter. The one possible virtue of the intact orifice lies in the possibility that the mucous covering which it possesses may play a rôle in the prevention of stenosis.

The fourth surgical principle is applicable to patients with uninvolved trigones or ureteral orifices (such as is the case in exstrophy and vesicovaginal fistula). It cannot be applied satisfactorily for any of the patients with malignancy.

THE FIFTH SURGICAL PRINCIPLE

Temporary Diversion and Drainage of Urine

a. By ureteral catheters transrectally.
   1. With axial implantation. The second principle. (Giordano, 1892, experimental.)
   2. With preservation of ureteral orifices. The fourth principle. (Peters, 1899.)
   3. With submucosal principle. The ninth principle. (Coffey, 1925.)

Modified by Furniss, 1930; Nitch, 1932; Green-Armytage, 1932.

4. With intact ureter. The eleventh principle. (Ferguson, 1931.)

b. By preliminary nephrostomy. (Heitz-Boyer and Hovelacque, 1912; Hinman, 1926.)

c. By extraperitoneal ureterostomy with a transfixion suture. The first principle. (Hinman, 1935.)

a. By Ureteral Catheters Transrectally.—The first record of the temporary drainage of urine following a uretero-intestinal anastomosis dates back to 1892 when Giordano, during experiments on dogs, used small ureteral tubes which he brought out through the rectum in one animal. The operation was a direct ureteral transplant executed by the extraperitoneal route. Death ensued shortly after operation from rectal hemorrhage.

In 1894 Rein in clinical practice employed small glass tubes for ureteral drainage, following a bilateral ureterorectal anastomosis by the direct method. Rubber tubes connected to the glass tubes were brought out through the rectum. The patient died shortly after operation from an unknown cause.

Peters, in 1899, first used ureteral retention catheters in combination with the principle of preservation of the ureteral orifice in the Bergenhem operation.

The use of catheters did not gain popularity until 1925 when Coffey devised his second technic in order to permit a one stage bilateral submucosal transplantation. With catheters he hoped to avoid a temporary interruption of the urinary stream which is so frequently caused at the site of anastomosis by edema immediately following operation. In placing a ligature around the end of the ureter as it coursed over the catheter he intended to shut off the tissue spaces of the ureter and prevent ascending infection.

Coffey's second technic (Fig. 13) is performed after the rectum has been clamped off and lavaged clean (Fig. 13 A and B) by first packing the rectum with gauze through a sigmoidoscope (Fig. 13C). The ureters are divided near the bladder, catheterized with as large a catheter as possible and tied around a rubber cuff. The cuff consists of a rubber tube three-fourths of an inch long which is tightly fixed at a point from 4 to 6 inches from the tip of the catheter by two or three strong linen sutures, one being taken around the catheter itself (Fig. 13, D, E and F).

Two oblique incisions 1.5 inches in length are made down to the submucosa of the rectosigmoid. These are placed low in order to make possible the removal of the catheters through a speculum introduced in the rectum should they become blocked. Narrowing of the bowel is avoided by placing one incision higher than the other (Fig. 13 G).

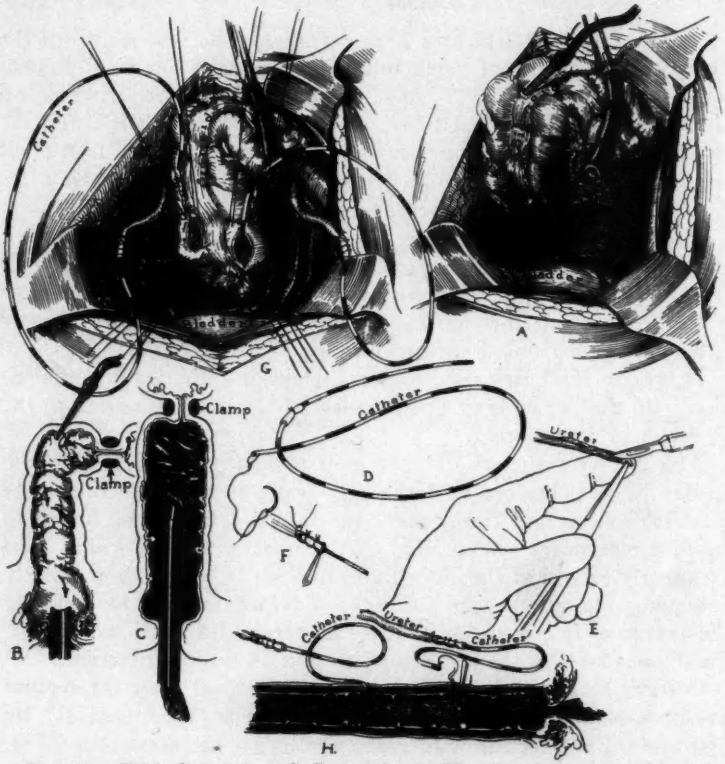

Fig. 13. Fifth Principle. Coffey's technic No. 2 (ninth principle), using ureteral catheters with the submucosal principle.

A. The bowel is clamped and the needle for irrigation inserted. *B.* Sectional view showing irrigation in progress. *C.* Packing the bowel with gauze. *D.* The ureteral catheter, size 12 F, prepared with a rubber cuff for fixation of the ureter and a suture at its end to be attached to the gauze for withdrawal of the catheter by way of the rectum. *E.* Splitting the end of the ureter. *F.* Catheter inserted into the ureter and tied in place on the rubber cuff by sutures. One suture is tied around the ureter above the cuff. *G.* The ends of the catheters are tied to the gauze in the rectum through stab wounds at the lower ends of the incisions which had been made down to the submucosal layer. *H.* Sectional view of *G.* (After Coffey.)

Two traction sutures of No. O chromic catgut are taken through the muscularis and serosa on either side of the lower extent of the incision in the bowel. A stab wound having been made through the submucosa and mucosa between the sutures, the ends of the catheters are attached to a bit of gauze drawn through the opening (Fig. 13 H). Upon withdrawal of the gauze from the rectum the catheters and ureters are guided into the incision. The traction sutures are tied together in order partially to close the rectal opening. A fine chromic catgut suture is taken through the wall of the ureter and the cut edge of mucosa on either side. Upon tying this suture the ureter is snugly held in position. Others sutures through the serous and muscular coats serve to implant the ureter in its submucosal course.

Furniss, in 1930, modified the second technic of Coffey by passing the catheters into the bowel on a special trocar to prevent soiling. Nitch, in 1932, used a rectal tube made of lead to draw the ureters into the rectum. Green-Armytage, in 1932, devised a stab instrument for passing the ureteral catheters through the mucosa into a Kelly cystoscope introduced through the anus by an assistant.

Charles Ferguson, in 1931, employed ureteral catheters in his experimental two-stage submucosal transplantation of the intact ureter which is discussed as the eleventh surgical principle (Fig. 31).

Discussion.—The outstanding objection to any form of ureteral catheter is its tendency to become blocked. Even the larger sized catheters are prone to clog with bits of mucus, blood clot, epithelial cells or calcareous incrustations. Poor drainage is the result and infection follows. Acting in the nature of a foreign body the catheter itself causes infection, either peri-ureteral or renal. Another objectionable feature is the tendency toward anemic necrosis when the ureter is too tightly applied over the catheter. Gangrene leads to leakage and peritonitis.

b. By Preliminary Nephrostomy.—Nephrostomy preliminary to ureteral implantation was first suggested by Heitz-Boyer and Hovelacque in 1912 as being useful from two points of view. In the first place, it reduces the infection of the kidneys which is present in most conditions amenable to uretero-intestinal anastomosis. In the second place, the diversion of the urine thus effected gives se-

curity during operation and in the days following, by preventing contamination of the field of operation with urine which ordinarily is infected, and by permitting the wound to heal without the danger of the complications which result from edema with occlusion of the newly formed orifice. These writers considered a bilateral nephrostomy to be the most satisfactory method of diverting the urine and they advised that the operation be performed three weeks prior to the uretero-intestinal anastomosis.

Hinman, in 1926, stressed the value of preliminary nephrostomy, particularly in severe infections of the bladder, such as tuberculosis, and in malignancy of the bladder causing obstruction to the lower portion of the ureter. He found the method especially valuable in those patients whose remaining kidney was undergoing progressive hydronephrotic atrophy because of obstruction of the transvesical portion of the ureter. In the congenital deformities, such as exstrophy of the bladder, when the ureters are not enlarged and function normally he claimed no advantage for the procedure.

Discussion.—Nephrostomy is the most suitable measure for diverting the urine from the operative field in cases in which this is indicated before establishing a communication between the ureter and bowel. It may be instituted in those patients who would be benefited by a ureteral transplant but who are poor surgical risks because of upper urinary obstruction and renal infection. These patients may be prepared over a long period, if necessary, before proceeding with a uretero-intestinal implantation. In fact, under certain circumstances (such as vesical tuberculosis), nephrostomy tubes may be worn indefinitely. While entailing an operative procedure of a magnitude which requires a separate stage, the surgical risk is slight and is well outweighed by the advantages gained under conditions of abnormality of the upper tract.

c. By Ureteral Catheters Placed Extraperitoneally from Ureterostomies Above the Site of Implantation.—Hinman, in 1935, presented a method for the diversion of urine by the use of catheters placed extraperitoneally in ureterostomy openings above the site of implantation. The procedure was used in conjunction with Coffey's third technic with a transfixion suture, in order to divert the urine during the time required for the transfixion suture to cut through, thus avoiding urinary obstruction and permitting simultaneous bilateral implantation.

In executing this method the ureter is exposed through a low midline or rectus incision by dissecting it free from the peritoneum above the pelvic brim. A No. 10 ureteral catheter is introduced into a small longitudinal slit made in the side of the ureter high in the area of reflected peritoneum as near the pelvic colon as possible, the distal end being brought out through the abdominal wound posterior to the peritoneum or through stab wounds in the groins. An intraperitoneal implantation of the ureter is then made into the rectosigmoid according to Coffey's third technic (transfixion suture). The peritoneum is closed and drains are placed extraperitoneally.

Discussion.—Although extraperitoneal ureteral catheters afford drainage until the transfixion sutures establish a fistulous tract into the bowel their employment is equally as undesirable as any type of retention catheter. The objectionable features are well demonstrated in two of Hinman's three patients who underwent drainage by extraperitoneal catheter. In one patient who recovered, an acute pyonephrosis developed following imperfect drainage by catheter, necessitating nephrectomy on this side, and in another, who died, necropsy revealed an acute renal infection with abscess formation, acute ureteritis and peri-ureteritis above the ureterostomy with an anemic infarct below.

The cases in which the principle of the temporary diversion of the urine has been applied have not been analyzed separately but under the more fundamental principle with which it has been combined as is indicated in the classification.

THE SIXTH SURGICAL PRINCIPLE

The Use of a Flap to Act as a Valve

a. Of the entire intestinal wall. (Vignoni, 1895, experimental.)
b. Of submucosa and mucosa. (Fowler, 1896.)
c. Of the trigone. The fourth principle. (Pisani, 1896, experimental.)

a. Of the Entire Intestinal Wall.—Vignoni, in 1895, was the first to employ the principle of a flap of the intestinal wall (or a part of it) at the site of ureteral implantation. His intention was to reproduce the structural arrangement existing in those animals possessing ureters which open into a cloaca. Using dogs, he implanted single ureters upon a V-shaped flap cut out of the anterior

Fig. 14. Sixth Principle. Fowler's method of forming a flap of submucosa and mucosa to act as a valve.

A. Incision on the anterior wall of the rectum through the serosa and muscularis, exposing a diamond-shaped area of submucosa. Outline of the incision through the submucosa and mucosa for raising a tongue-shaped flap. *B*. The obliquely divided ends of the ureters sutured side by side on the presenting mucosal surface of the flap. *C*. Flap inserted into the lumen of the bowel and the opening closed by uniting the outer edges of the mucosal-submucosal layers with interrupted sutures. *D*. Closure of the muscularis and serosa with a line of interrupted sutures. *E*. Sectional view showing the position of the flap with the bowel empty. *F*. The flap being directed over the ureteral orifice with the passage of feces. *G*. The probable atrophied fate of the flap. (After Fowler and Coffey.)

rectal wall. After being placed upon the flap the ureter was buried by the careful suture of the two lateral folds of bowel over it. Of seven dogs, one recovered and lived for more than two months.

b. Of Submucosa and Mucosa.—One year later Fowler applied the principle of an internal flap (Fig. 14). He attempted to construct an efficient permanent valve of mucous membrane so covering the open mouths of the ureters as to close the ureteral orifices when the rectum became filled with urine and to protect them when fecal matter descended from above. As an additional safeguard against ascending infection, he advocated the submucous principle of oblique insertion, bringing the ureters on the submucosa of the rectal wall for a distance of three or more centimeters before they entered the intestinal lumen. In this situation he claimed that the circular fibers of the bowel compressed the ureters and secured occlusion during the act of defecation.

Fowler's flap is constructed by making an incision 7 cm. long on the anterior wall of the rectum through the serous and muscular coats. These layers are dissected laterally until the submucosa is bared in a diamond-shaped area. A tongue-shaped flap of mucous membrane and submucosa, with its base directed upward, is next cut from the the lower half of the diamond. This flap is doubled upon itself in such a manner that one-half of its mucous surface presents anteriorly, where it is fixed with one or two catgut sutures. In this way a flap, both sides of which are covered with mucous membrane, is secured.

The ureters are placed side by side in the incision, so that their obliquely divided ends lie upon the presenting mucosal surfaces of the flap. A few fine catgut sutures serve to secure the ureters in the submucosal space. The flap with the attached ureters is inserted into the cavity of the rectum and the rectal wound closed in layers over it.

Duval and Tesson (1899) further studied this type of operation in dogs, stressing the oblique submucous course of the ureters and the formation of a mucosal valve. From their experiments, which proved unsatisfactory, they concluded that it was impossible to reproduce surgically the mechanism of the ureterovesical orifice in anastomosing the ureter to the digestive tract.

c. Of the Trigone.—Another experimental method employing the flap principle was combined with Maydl's technic by Pisani, in

TABLE VII. FORMING A VALVE BY THE USE OF A FLAP WITHIN THE BOWEL (FOWLER'S METHOD)
The Sixth Surgical Principle

Condition		I. Congenital Anomalies and Trauma	II. Vesical Infection (Ulcer)	III. Malignancy	IV. Not Stated	Total
Number of Cases		2		1	1	4
Deaths: Surgical	S	1		1	1	3
Late	L					
Causes: Shock	S					
	L					
Pneumonia	S					
	L					
Urinary Infections	S	1		1		
	L					
Urinary Obstruction	S				1	
	L					
Peritonitis	S					
	L					
Bowel Obstruction	S					
	L					
Not Stated	S					
	L					
Total Deaths		1		1	1	3

Summary: 4 cases, 3 deaths

1896. He resected a square area of trigone bearing the ureters and fixed it to a freshened portion of the posterior rectal mucosa by means of silk sutures. The flap was introduced through an anterior rectal incision which was thereafter closed, the ureters entering at either extremity. Two dogs upon which the method was tried died in sixty-two hours and six days respectively, the first of opera-

tive shock, the second, of peritonitis. The kidneys and ureters were found to be normal, the urine uninfected and the flaps adherent in both animals.

Summary of Cases.—The Fowler operation has been performed on only four patients. Three died shortly after operation, yielding a surgical mortality of 75 per cent. The fourth was well and free from any evidence of renal infection when observed three and one-half years later. Urinary infection accounted for two of the deaths, urinary obstruction for the third. These cases are analyzed in Table VII. The remaining procedures using the flap principle (Vignoni and Pisani) have not been subjected to clinical trial.

Discussion.—The idea that a flap might be formed to act as a valve is closely related to the submucosal principle used experimentally by Krynski in 1896 and popularized later by the splendid experimental and clinical studies of Coffey (Ninth Surgical Principle). The use of a flap, however, as employed by Vignoni, Fowler and Duval and Tesson fails in practice because it undergoes rapid atrophy following operation.

Pisani's procedure is irrational, yet one is attracted by the bold ingenuity which inspired the originator to form a valve by stringing the ureters across the rectum as a means of fixing a trigonal flap to the mucosa of the posterior wall. The most objectionable feature in the operation is the long extent of unprotected ureter which is allowed to lie in the rectum. An arrangement of this kind exposes the ureters to the repeated trauma of the passing urine and feces as well as opening them to a continual source of infection.

THE SEVENTH SURGICAL PRINCIPLE

The Use of Mechanical Devices

a. The button of Boari (1895).
b. The copper tubes of Chalot (1896).
c. The bobbin of Evans (1899).
d. The "dress-snap" of Zollinger (1934), experimental.

a. The Button.—In 1895 Boari introduced the principle of a mechanical device for performing uretero-intestinal anastomosis. As a means of avoiding stenosis and ascending urinary infection he designed buttons which were of sufficient size to assure a wide opening upon sloughing their way into the rectum (Fig. 15).

From four sizes it was possible to choose a button adapted to the size of the ureter. The buttons consisted of two disks mounted upon a hollow stem which served for the passage of urine. The disks remained spread apart by a spring which in preparation for operation was compressed and held in position by a stylet passed transversely through two apertures in the stem. The end of the ureter was drawn over the collar-like head of the button and secured with a silk ligature. The disks were next inserted into the lumen of the bowel through a small rectal incision, a pursestring

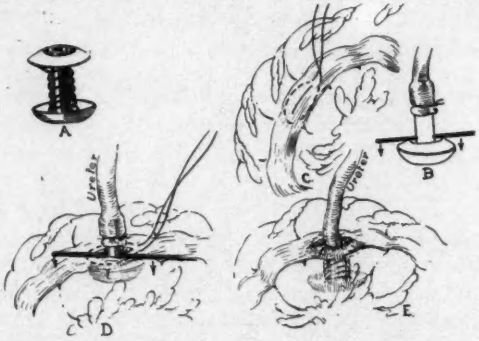

Fig. 15. Seventh Principle. Boari's mechanical button.

A. Button open. *B*. Stylet compressing spring and holding disks together. End of ureter drawn over the collar-like head of button and held with a silk ligature. *C*. Incision in rectal wall for introduction of button. Purse-string suture laid. *D*. Disk end of button introduced into bowel lumen, stylet remaining outside. *E*. Purse-string suture tied, stylet removed, wall of bowel brought into close contact with end of ureter by traction of spreading disks. (After Boari.)

suture closing the bowel around the stem of the button, the stylet remaining outside. Upon withdrawal of the stylet the end of the ureter was brought into firm contact with the wall of the bowel by the traction exerted by the immediate spreading of the disks. Boari advised an extraperitoneal approach for the operation.

Meeting with success in carrying out this procedure on four dogs, Boari performed a unilateral transplant in a patient suffering from a vesicovaginal fistula. The patient was well six months later, passing part of her urine by rectum and the remainder by vagina. In a previous case, one of tuberculous cystitis, Casati had performed a unilateral transplant, death resulting in thirty-five days from advanced tuberculosis of the lungs, peritoneum and bladder.

Boari subsequently modified his button so that it would not cut

through so rapidly. He also made the head more blunt so that it would not injure the rectum in being passed. Later he devised a button for a lateral ureteral transplant which was to assure a still larger orifice for the prevention of stenosis.

Boari carried out further experiments in the preservation of the ureterovesical valve by attaching to the button either the entire trigone (Maydl) or single ureters with a rosette of surrounding vesical mucous membrane (Bergenhem).

Roux, in 1900, anastomosed the right ureter to the appendix with a Boari button. The patient died from peritonitis resulting from gangrene at the site of anastomosis.

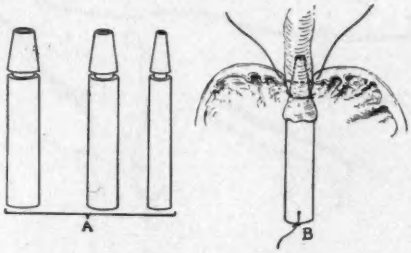

Fig. 16. Seventh Principle. The copper tube method of Chalot.
A. Various sizes of the tubes. *B*. Sectional view of uretero-intestinal transplant by the use of a tube. (After Chalot.)

b. The Copper Tubes.—The first successful bilateral uretero-intestinal implantation after an operation for malignancy was performed by Chalot in 1896 with another mechanical device. He used cylindrical nickel-plated copper tubes which tapered in the form of a cone at each end (Fig. 16). These were fixed in the ureter by a ligature and implanted in the intestine with sutures placed through the serosa and muscularis.

Through a perforation in the lip of the intestinal end of the tube was passed a loop of silk which served either of two purposes. It fixed a catheter to the end of the tube or acted as a means of traction for removing the tube by way of the rectum should it remain in place for too long a time without sloughing through. He made the lumen of the tube as large as possible to overcome the danger of occlusion by calcareous incrustations.

In 1898 Lestrade used Chalot's tubes for uretero-intestinal implantation in four dogs. The result was fatal in each instance, the

animals dying of renal insufficiency, leakage of urine into the peritoneal cavity and peritonitis.

c. The Bobbin.—Evans, in 1899, performed a unilateral ureterorectal transplant by means of a bobbin. Although a fecal-urinary fistula developed, the patient was well thirteen months later.

Mechanical devices proved so unpopular that no further experimental or clinical transplantations were made with them until 1934.

d. The Dress-snap.—In 1934 Zollinger revived the method in presenting a device for which he claimed an aseptic technic, pro-

Fig. 17. Seventh Principle. Zollinger's mechanical drainage button.

A. The drainage button, similar to the male and female portions of a dress snap, with sections of a No. 7 ureteral catheter attached, the female portion to the left, the male to the right. *B.* The female portion grasped through the mucosa and submucosa in the incision in the bowel, the male portion about to be snapped in place. *C.* Sectional view of completed anastomosis. (After Zollinger.)

tection of the end of the ureter for a sufficient period to allow for occlusion of the lymphatics and, at the same time, a free drainage of urine.

In developing his drainage button, Zollinger first devised a modification of the common dress-snap. Later he made a rectangular metal box which was designed to permit the end of the ureter to project into the lumen of the bowel. The box, however, was too large, permitting a slough and the frequent development of peritonitis. Finally Zollinger perfected a small drainage cap made in two parts, a female and a male (Fig. 17). Each

TABLE VIII. SECURING BETTER ANASTOMOSIS MORE SAFELY BY THE USE OF MECHANICAL DEVICES (BOARI)

The Seventh Surgical Principle

Condition		I. Congenital Anomalies and Trauma	II. Vesical Infection (Ulcer)	III. Malignancy	IV. Not Stated	Total
Number of Cases		3	2	8		13
Deaths: Surgical	S		1	6		7
Late	L					
Causes: Shock	S			1		
	L					
Pneumonia	S					
	L					
Urinary Infections	S		1	3		
	L					
Urinary Obstruction	S					
	L					
Peritonitis	S			1		
	L					
Bowel Obstruction	S					
	L					
Not Stated	S			1		
	L					
Total Deaths		0	1	6		7

Summary: 13 cases, 7 deaths

part is attached to sections of a No. 7, whistle-tip, ureteral catheter divided six inches from the tip, one catheter extending up the ureter and the other out through the anus. The female portion of the button, with the end section of the catheter attached, is inserted through the anus into the rectum and is brought beneath

the rectal incision which has been made down to the submucosal layer. It is grasped between the thumb and index finger of the left hand and held in place against the mucosa. The male portion fixed to the six-inch length of the tip of the catheter is then snapped into this hidden female portion, perforating the mucosal-submucosal layers.

After the injection of sterile fluid has established the fact that both parts of the button and the two catheters are clear, the ureter is threaded onto the catheter of the male portion and is fixed by the previously placed sutures. The end of the ureter is likewise anchored to the mucosa in order to hold it in place after the sloughing out of the button. A submucosal implantation of the ureter completes the anastomosis.

Zollinger performed unilateral transplants in eighteen dogs, with six good results. One serious difficulty was that the dogs bit out their rectal catheters too soon after operation. Although the operation has not been applied clinically, Zollinger believes that the results should be more satisfactory because of larger caliber of the ureter.

A contrivance which screws together, which Zollinger is still developing, will be an improvement over the present dress-snap, he states, the insecure coaptation of which has caused failure in a small proportion of his operations.

Summary of Cases.—The thirteen operations which have been performed by the use of the various mechanical devices are analyzed in Table VIII. Seven deaths are reported, all surgical, making a 54 per cent mortality. Renal infection is the most frequent complication, having occurred in four cases (30.8 per cent). Fistulæ and peritonitis developed in two cases each (15.4 per cent).

Discussion.—The many obvious disadvantages of any mechanical device—the danger of urinary obstruction, of gangrene of the ureter and bowel, of peritonitis—are so overwhelming that the one advantage, that of shortening a technically difficult and prolonged operation, is completely outweighed.

THE EIGHTH SURGICAL PRINCIPLE

Implantation into Structures which open Normally into the Gastro-intestinal Tract

a. Appendix (Roux, 1900; Eaton, 1910).
b. Pancreatic duct (Baird, Scott and Spencer, 1917, experimental).

c. Gall-bladder (Dardel, 1922, experimental; Kehl, 1923, experimental).

a. The Appendix.—Roux anastomosed the right ureter to the appendix by the use of a Boari button in 1900. The first ureteroappendiceal implant by suture was performed by Eaton on March 6, 1910. Eaton advised an appendiceal transplant because of the following factors which, he claimed, reduced the possibility of ascending urinary infection: (1) There is less putrefaction in the cecum than in the rectum. (2) A natural canal facilitates transportation of urine and eliminates muscular mutilation elsewhere.

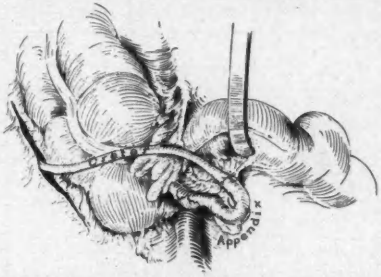

Fig. 18. Eighth Principle. Eaton's method of end-to-end anastomosis of the right ureter to the appendix. (After Beck.)

(3) The opportunity for peritoneal contamination is lessened. (4) The operation does not hinder peristalsis, rendering ileus a less likely complication. (5) The ileocecal valve forms a pseudovalve over the orifice of the appendix.

The technic consists in amputating approximately one and one-half inches of the end of the appendix and suturing the transversely divided end of the ureter directly over the appendiceal lumen by interrupted sutures made in two or more layers (Fig. 18).

Babcock, on April 22, 1910, carried out a similar end-to-end anastomosis of the right ureter to the appendix modifying the operation by making an extraperitoneal transplant.

Summary of Cases.—Ten uretero-appendiceal transplants collected from the literature are analyzed in Table IX and show an operative mortality of 60 per cent. Of the complications following operation, renal infection, peritonitis and urinary obstruction were most frequent, each occurring twice.

TABLE IX. PREVENTING ASCENDING INFECTION BY INSERTION INTO A NATURAL DUCT

The Eighth Surgical Principle

Condition		I. Congenital Anomalies and Trauma	II. Vesical Infection (Ulcer)	III. Malignancy	IV. Not Stated	Total
Number of Cases		5	1	3	1	10
Deaths: Surgical	S	2		3	1	6
Late	L		1			1
Causes:						
Shock	S					
	L					
Pneumonia				0.5		
	L					
Urinary Infections	S					
	L		1			
Urinary Obstruction	S					
	L					
Peritonitis	S	1		0.5	1	
	L					
Bowel Obstruction	S					
	L					
Not Stated	S	1		2		
	L					
Total Deaths		2	1	3	1	7

Summary: 10 cases, 7 deaths

b. Pancreatic Duct.—Baird, Scott and Spencer (1917), using dogs as experimental animals, guided the end of the ureter into the lumen of the duodenum through the pancreatic duct. They found that the implanted ureter and kidney functioned normally and did not become infected although the dog died in from seven

to twelve days if the other kidney was removed. Death resulted, in their opinion, from uremia caused by the reabsorption of urine from the upper gastro-intestinal tract. They concluded that a valve was not necessary at the uretero-intestinal junction.

c. Gall-bladder.—Dardel, in 1922, and Kehl, in the following year, implanted the right ureter to the gall-bladder by the direct method. They, too, were seeking a method to avoid ascending urinary infection. Dardel subsequently joined the left to the right ureter whereas Kehl tied off the left ureter or removed the left kidney.

Although Dardel denied that the procedure resulted in urinary infection, Kehl noted its presence in a few of his experiments. All of Dardel's dogs died of chronic enteritis while Kehl's animals uniformly succumbed to uremia. Dardel suggested the possible use of the operation in man, especially in cases of exstrophy. Kehl, on the other hand, concluded that this method of diverting the urine is not practical.

Discussion.—Aside from qualifying as an outlet for only one ureter and the fact that it is absent in many patients, the appendix presents many features which render it undesirable for ureteral anastomosis. Susceptibility to acute inflammation, fecal impactions and stenosis make it unsatisfactory from the point of view of possible obstruction and ascending infection. The curved course which the ureter and affixed appendix must take in entering the cecum favors urinary obstruction. Babcock correctly pointed out that the method does not obviate cicatricial contracture of the divided end of the ureter.

The upper intestinal tract, being free from putrefactive bacteria, presents an ideal location for ureteral implantation from the standpoint of infection. The factor of urinary reabsorption, however, renders the site wholly impractical. Dogs with bilateral ureteroduodenostomy die in the same length of time and in the same condition as after bilateral nephrectomy (Hinman and Belt, 1922).

Lacking any similar study on the cecum, one can only speculate as to whether it, too, may not function in a like manner as regards urinary reabsorption. It is true that the completely excluded cecum has served without ill effect as a urinary reservoir (Makkas, 1910), but such an arrangement is not comparable to subjection of the entire absorptive area of the large bowel to all

of the urinary output. Uretero-intestinal transplantations to the rectosigmoid are undoubtedly accompanied by some measure of intestinal urinary reflux. Turner and Saint recently (1936) presented convincing evidence that following uretero-rectoneostomy not only the rectosigmoid but the remaining portion of the large bowel, as well, may act as a reservoir for urine. In four of six patients studied by serial x-rays following intravenous pyelography they noted the reflux of urine as far back as the cecum. Even a tolerance for partial urinary reflux, however, cannot be considered as proof that urine is innocuous to the cecum. In fact, the elevation of blood urea nitrogen which Turner and Saint and other workers have noted, might find some explanation in urinary reabsorption as well as in depressed renal function. Until the problem is solved, one should be hesistant of utilizing the appendix or cecum proper as a site for ureteral transplantation. Lahey, in 1935, advised against ureteral implantation to the cecum because in one case in which he transplanted the right ureter to this structure an intractable diarrhea resulted.

THE NINTH SURGICAL PRINCIPLE

The Submucosal Principle (Valve Action).

a. The triangular exposure of the submucosa (Krynski, 1896, experimental).
b. Coffey's technic No. 1 (experimental, 1910; clinical, 1913).
(After the method of Coffey [1909] of submocosal transplantation of the common bile duct into the intestine.)
c. Mayo's modification (catgut urine guide) (1912). (Coffey-Mayo operation.)
d. Cabot's extraperitoneal modification of Coffey's technic No. 1 (1921).
e. Coffey's technic No. 2 (1925) with catheter drainage. The fifth surgical principle.
f. Furniss' modification (1928) preserving peritoneal attachment.
g. The modification by the use of approach tunnels,
Mayo, 1930.
Papin, 1930.
Walker-Taylor, 1930. Open tunnel (first plan), closed tunnel (second plan); aseptic irreversible tunnel (third plan).
h. Coffey's technic No. 3 with transfixion suture (1930). The first surgical principle.
i. The simple aseptic method with a divisible carrier (Hinman, 1935).

j. Aseptic submucosal transplant by use of an electric snare (Foley, 1936).
k. Aseptic submucosal transplant by use of a barb (Palmer, 1936).

a. The Triangular Exposure of the Submucosa.—In attempting to imitate the normal ureterovesical entrance, Krynski, in 1896, performed the first submucosal transplantation of the ureters into the bowel. Experimenting on dogs he claimed that no case of ureteral or renal disease attended the use of the following method (Fig. 19).

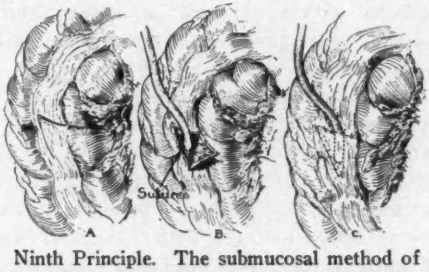

Fig. 19. Ninth Principle. The submucosal method of Krynski.
A. Raising a triangular flap of muscularis and serosa on the anterior wall of the sigmoid. *B*. The obliquely divided end of the ureter sutured into a small incision through the mucosa at the apex of the triangle. *C*. The flap sutured back in position, avoiding compression of the ureter. (After Krynski.)

A triangular incision from 2.5 to 3 cm. by 1 cm. was made through the serosa and muscularis on the anterior margin of the gut just below the sigmoid flexure. The area thus outlined was dissected up in the form of a flap exposing a triangular area of submucosa. After dividing the end of the ureter obliquely it was sewed by four interrupted sutures to the edges of a small incision in the mucosal-submucosal layers at the apex of the triangle. The previously raised flap was then sutured back into position, exercising care not to compress the ureter.

Fowler, in 1896 (Fig. 14), and Duval and Tesson, in 1899, combined the submucous transplant with an internal bowel flap (the sixth surgical principle) and Beck, in 1899, combined it with Martin's muscularizing operation (the third surgical principle).

In 1903, Thompson performed an operation which was originally intended for Maydl's procedure but finally terminated in a submucosal type of implantation with the ureteral orifices intact. In treating a girl three years of age for exstrophy, he dissected out the trigone bearing the ureters and sutured it to the margins of

the hymen. At a second operation two weeks later it was found that the trigone uniting the ureteral orifices had sloughed away leaving the orifices, however, intact. He raised two quadri-lateral flaps of serosa and muscularis from the convex surface of the sigmoid flexure. The hinges of the flaps were on the lateral aspects of the gut and the meeting point was the middle of the anterior muscle band. A small opening was made in the mucosal membrane at the lower end of the denuded area and the ends of the ureters were implanted side by side therein, and were held together by sutures which did not penetrate their lumina. A temporary retaining suture placed through the wall of each ureter, again avoiding the lumen, was anchored in the gut three-fourths of an inch below the opening in the mucosa. With fine silk the edge of the opening in the gut was united to the sides of the ureters. The muscular flaps then were sutured in place over the ureters, care being taken to apply the upper border of the flaps around the entering ureters. Lastly, the temporary ureteral anchoring sutures were removed and the entire site was walled off with omentum. The patient was well one year later.

b. Coffey's First Technic.—In 1909 Coffey described a method of submucosal transplantation of the common bile duct into the intestine. In closing his paper, he mentioned that this same principle might solve the problem of uretero-intestinal anastomosis.

The following year he reported experimental studies on the submucosal transplantation of the ureter. Of nine dogs undergoing this type of operation, five recovered from operation and showed no dilatation of the ureters or damage to the kidneys after periods of from 60 to 167 days. Six control experiments by the direct method resulted in pyonephrosis in five instances, and total destruction of the kidney in the sixth.

The operation, described by Coffey as his first technic (Fig. 20), is carried out intraperitoneally and preferably in two stages. Having located, dissected free and divided the ureter, the end is prepared by slitting it for a short distance. A linen suture is passed through the entire wall near the extremity and tied on either side, the loose ends being threaded on two needles. The submucous canal is prepared by incising the intestine at the elected site through the serous and muscular coats until the mucosa pouts through the incision. Five or six interrupted sutures are taken which catch

the peritoneum and muscular layers. The uppermost suture is tied and used as a control suture, the intermediate sutures being held away from the wound with a flat instrument. The end of the ureter is brought beneath the sutures and the two needles are passed through a stab wound made in the mucosa at the lowest point of the incision. The needles are brought out three-fourths of an inch farther along, about one-eighth to one-fourth of an inch apart. The ureter being drawn snugly down, this anchoring suture is tied outside the intestine, incorporating all layers. The

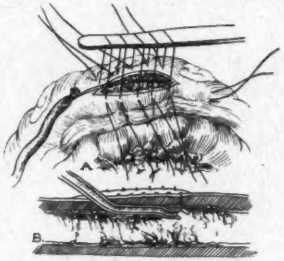

Fig. 20. Ninth Principle. The submucosal method of Coffey (Technic No. 1).

A. The anchoring suture, after transfixing the end of the obliquely divided ureter, enters the lumen of the gut through a stab wound at the lowermost point of the incision, previously made down to the submucosa, and emerges through all layers of the intestine three-fourths of an inch farther along. *B*. Sectional view of the transplant showing the submucosal course of the ureter and the anchoring suture tied. (After Coffey.) Compare *B* with *G* in Figure 9 (Stiles).

ureter is tacked to the serosa of the intestine at its point of entrance by a few fine sutures, those previously laid being tied, thus enclosing the ureter in the submucosal space. The other ureter is implanted in like manner from two to three weeks later. An important point in technic, according to Coffey, is the placement of a rubber sheet with multiple wick drains down to the site of implantation. He called this the "quarantine drain."

In 1931, Middleton published an article claiming to have performed, on March 1, 1911, the first operation on a human subject by Coffey's first method. He reported that the patient, a young man seventeen years of age suffering from exstrophy, was living and well twenty years later.

Previous to Middleton's claim, it was generally believed that Mayo was the first to apply Coffey's principle of submucous trans-

plantation in man. He performed a two-stage operation on February 3 and February 23, 1912, Coffey not having made his first clinical application of his operation until October 17, 1913.

c. Coffey-Mayo Operation.—Mayo, in 1912, slightly modified Coffey's original technic by introducing a catgut urine guide. By this modification, an end of No. 2 chromic catgut 6.25 cm. in length

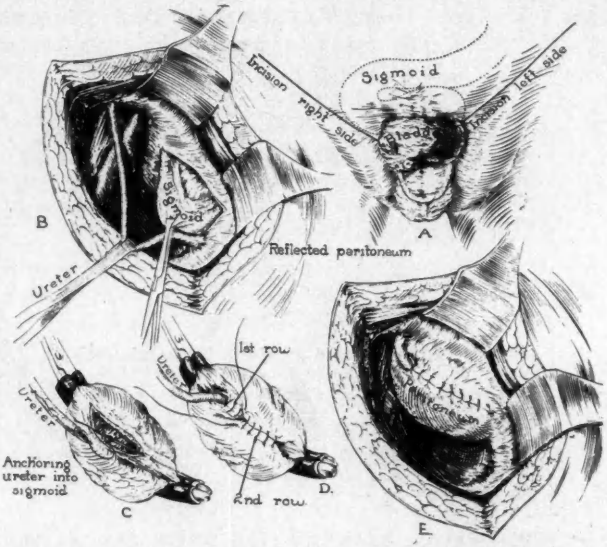

Fig. 21. Ninth Principle. Cabot's extraperitoneal modification of Coffey's submucosal implantation of the ureter (Technic No. 1).

A. The line of skin incisions. *B.* The ureter is freed and the sigmoid drawn through the opening made in the peritoneum. *C.* Submucosal implantation of the ureter as in the Coffey No. 1 technic. *D.* A second row of sutures in the wall of the sigmoid closing in the site of implantation (étagenaht). *E.* Suture of peritoneum over the site of implantation. (After Cabot.)

is left protruding up the ureteral lumen, through the site of the anastomosis. Mayo claimed that the urine, by following this guide can always leak out of the bowel regardless of slight kinks which might otherwise be obstructive. This idea, together with other less important changes, such as the use of the intestinal clamp, proved so popular that the method of implantation became widely known as the Coffey-Mayo operation.

Markoff, in 1934, described a slight modification of the Coffey-

Mayo operation. He sutured the ureter to the bowel prior to embedding it submucosally and slit the end for a distance of from 0.5 to 1 cm. before placing the anchoring suture, in order to prevent obstruction when edema takes place during the early days following operation.

In the same year, Everidge presented an inflatable intestinal bag in order to facilitate and add to the precision of the incision down to the mucosa in the submucous operation.

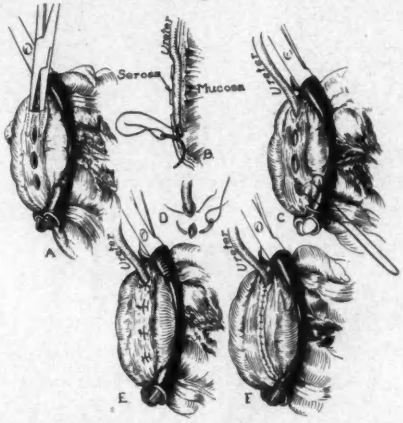

Fig. 22. Ninth Principle. The Coffey-Mayo operation; submucosal implantation of the ureter with approach tunnel.

A. Isolation of a segment of the sigmoid, a series of small, horizontal niches through the serosa and muscular coats joined by tunneling. *B.* Sectional view of the ureter introduced into the tunnel by an anchoring suture of catgut. An opening has been made through the submucosa and mucosa. The needle threaded on the catgut passes into the lumen of the sigmoid and out through its walls. *C.* The identical step down from without the sigmoid. *D* and *E.* Interrupted sutures through the serosa and muscularis including a small portion of the adventitia of the ureter at the points where niches were made. *F.* Second row of sutures over the primary suture line (étagenaht). (After Mayo.)

d. Cabot's Extraperitoneal Technic.—In 1921, Cabot described his technic for performing extraperitoneally the submucosal operation of Coffey (Fig. 21). This method also was used by Judd and, in 1935, Lahey described a similar procedure.

e. Coffey's Second Technic.—In 1925, Coffey presented his second technic, a one-stage bilateral submucosal transplant with catheters. This has been discussed in the section on diversion of the urine (the fifth surgical principle).

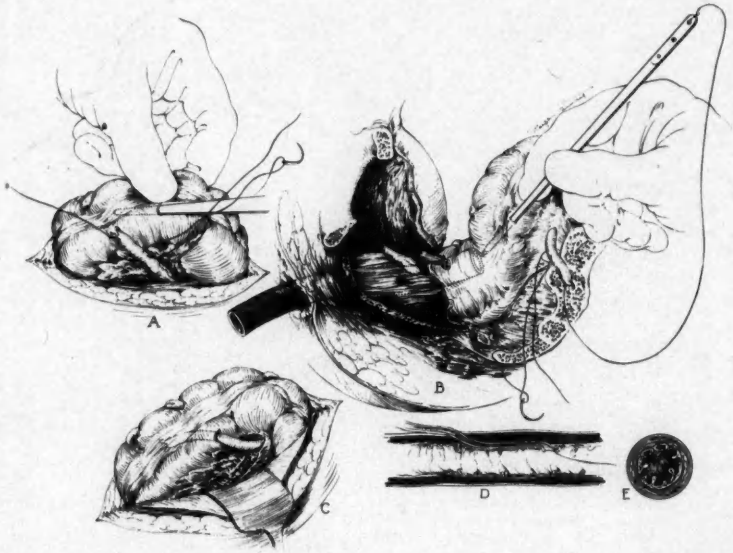

Fig. 23. Ninth Principle. Walker-Taylor's aseptic irreversible tunnel technic. A modification of Coffey's submucosal technic No. 1.

A. The tunnel being formed between the muscularis and the submucosa with the blunt dissector. *B.* Piercing instrument in the tunnel pointing into the rectal cylinder just about to perforate the intervening layer of the mucosa and submucosa. *C.* The operation complete. Eight mm. of ureter projecting into the bowel, fixed by a silk ligature attached at the anus. *D.* Longitudinal section showing the submucosal course of the ureter. *E.* Cross section of the submucosal course of the ureter. (After Walker-Taylor.)

f. Furniss' Modification.—Furniss, in 1928, advised retaining the peritoneal attachment to the ureter when freeing the portion for anastomosis by the second technic of Coffey. He did this to preserve better the blood supply to the lower ureter.

g. Approach Tunnels.—Papin, in 1925, carrying out Coffey's type of submucosal transplant, described a method for tunnelling beneath the muscularis of the bowel by making two transverse incisions 15 mm. long and about 3 cm. apart.

Mayo, in 1930, further modified the Coffey-Mayo operation by tunnelling beneath the muscularis through transverse nicks, in a manner similar to Papin's modification (Fig. 22).

In the same year, Walker-Taylor developed his method of tunnelling when performing the submucosal transplant. After making a small transverse incision through the serosa into the muscularis, a blunt instrument is introduced into the wall of the gut between the mucosa and the circular muscle layer, forming a tunnel for a distance of 1.8 to 2.5 cm. According to his first plan, called the technic of the open tunnel, the mucosa which presents at the end of the tunnel is opened with a thin knife or pair of scissors and the ureter is implanted with an anchoring suture, as in Coffey's first technic. The entire operative area is then buried by a longitudinal suture line which picks up peritoneum and muscle on either side. Walker-Taylor stated that ureteral catheters can also be used with this method.

In a second plan, known as the technic of the closed tunnel, the tunnel is made in a like manner but the mucosa at the end of the tunnel is perforated with an instrument shaped like a pencil. Upon withdrawing this instrument, a long, straight needle bearing the anchoring suture is passed to a point 8 mm. below the end of the tunnel and no infolding sutures are used. This plan likewise can be adapted to the use of ureteral catheters. The advantages over the first plan, according to Walker-Taylor are: (1) It diminishes the risk of obstruction by infolding sutures. (2) It eliminates the risk of leakage from the bowel.

In his third and final plan, known as the technic of the aseptic irreversible tunnel (Fig. 23), Walker-Taylor passes a long instrument like a darning needle through the mucosa at the end of the tunnel and out through the rectum. A cylinder applied through the rectum against the mucosa facilitates the passage of the instru-

ment. Eight millimeters of ureter is allowed to project into the bowel, the end of the ureter being fixed in place with a strong silk ligature which is left long and attached at the anus. This sloughs in a few days, the usual suture at the entrance of the tunnel maintaining the ureter in place. In thirty-four operations on dogs, using this third technic, peritonitis did not occur.

h. Coffey's Third Technic has been discussed under the first surgical principle.

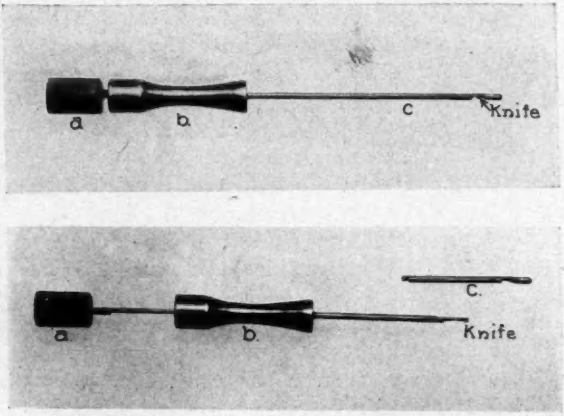

Fig. 24. *(Above)* Ureteral carrier (assembled).

A. Cutting stylet. *B*. Handle. *C*. End piece with cup into which the end of the ureter is to be tied. The stylet is partially withdrawn showing the knife.

(Below) Ureteral carrier (divided).

In order to free the end piece, *c*, the cutting stylet, *a*, must be fully withdrawn into the handle, *b*. It has been pushed out subsequently in this picture in order to show the knife.

i. The Simple Aseptic Method with a Divisible Carrier.—Aiming to simplify the surgical technic of the submucosal operation, a simple seven-suture method, using a probe and cautery, was presented by Hinman in 1935 with the report of twelve cases.* Sub-

*A simple seven-suture method of bilateral uretero-intestinal implantation. Report of twelve cases. Surg., Gyn. and Obst., 61:802-815, (December) 1935.

§Uretero-intestinal implantation by an aseptic method with a divisible carrier. (A modification of the simple seven-suture method with probe and cautery.) Trans. Am. Assn. Gen.-Urin. Surg., 29:157, 1936.

sequently a carrier was devised to replace the probe§ (Fig. 24).

Of importance to success by this technic are the preparation of the patient for operation and the exact performance of certain

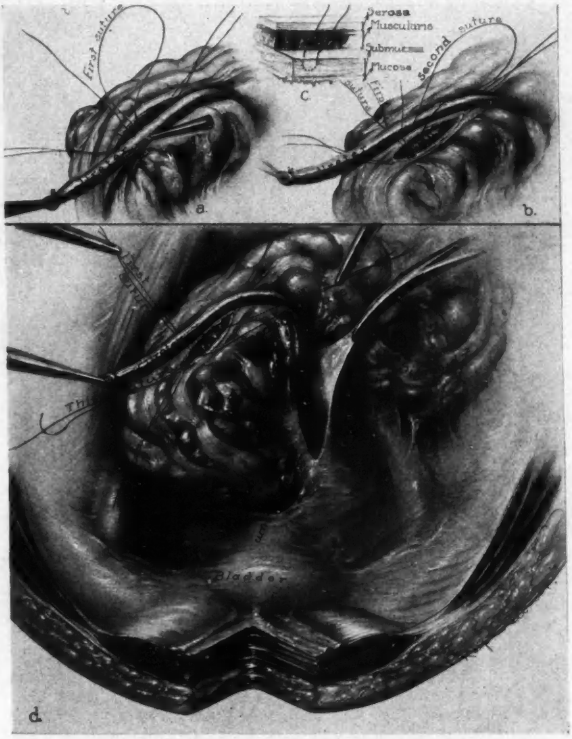

Fig. 25. The manner in which the three anchoring sutures are placed.

a. Suture, number 1, passed from left to right through the submucosa, right to left through the adventitia, care being used not to enter the lumen of the bowel or ureter. *b.* Suture, number 2, is passed opposite number 1. *c.* Shows how each suture is placed in the submucosa. *d.* Shows the triangle of submucosa marked off by the three sutures.

surgical details of suturing. The lower bowel must be empty. The ureter, untraumatized in the course of isolation and with its

§See footnote on page 84.

cranially directed blood supply unimpaired, must enter the bowel by the shortest, most natural route, untwisted, without kinks and reasonably loose. The incision in the wall of the bowel at the place to permit this easy entrance of the ureter must be short (from 2 to 3 cm.) and expose the submucosa without injury to

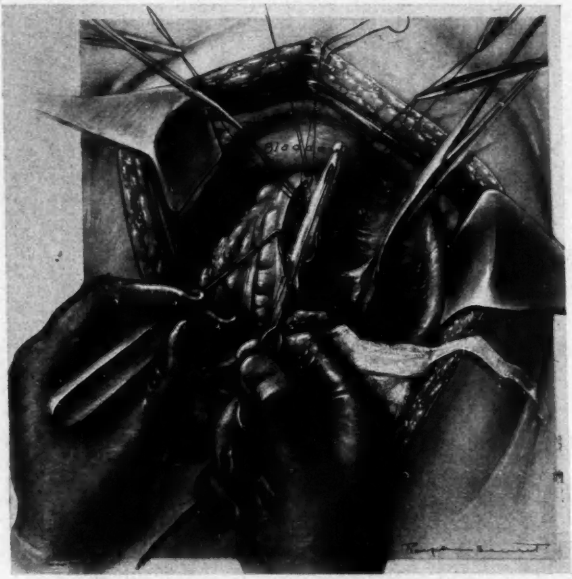

Fig. 26. The method of inserting the ureter with the probe through the opening into the bowel made by the cautery. After the ureter is inserted, the mosquito clamps with rubber guards, which are not shown in the illustrations, on the loops of sutures No. 1, No. 2 and No. 3, are withdrawn and these sutures are drawn tight and tied, thus anchoring the ureter in position, as shown in Figure 28.

any blood vessels in it. The three anchoring sutures (of twenty-day quadruple 0 catgut on atraumatic needles) must be placed on the definite plan of a triangle (Fig. 25) near the apex of which the incision for insertion of the ureter into the bowel will be made later (Fig. 26) so that, when tied, the ureter is sealed in without constriction and the closure is secure against leakage. The sutures

must pierce only the adventitia of the ureter and only the submucosa of the bowel, in order to be aseptic. The end of the

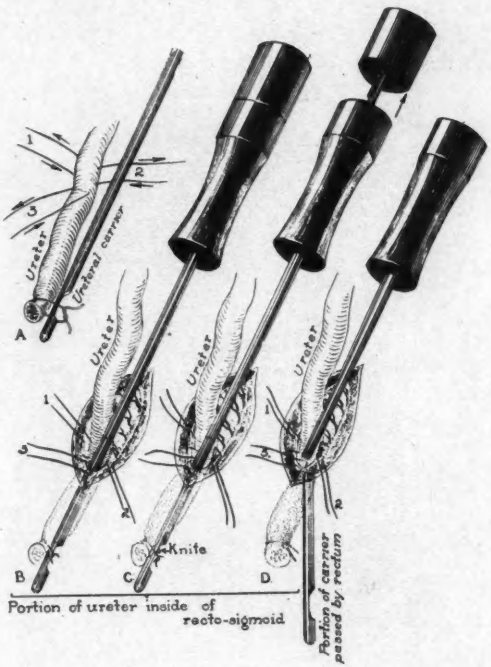

Fig. 27. Illustrates the use of a divisible carrier for insertion of the end of the ureter into the lumen of the bowel.

A. The end of the ureter is being ligated to the fenestration in the ureteral carrier. *B.* The end of the ureter, ligated to the fenestration in the ureteral carrier, has been introduced through an opening previously made with the cautery. The sutures, 1, 2 and 3, penetrating the submucosa of the rectosigmoid as well as the adventitia of the ureter are tightened so as to hold the ureter in place. *C.* The knife of the ureteral carrier dividing the ligature which frees the end of the ureter and the end of the carrier within the lumen of the bowel. *D.* The end-piece of the ureteral carrier freed within the rectum, when the stylet is withdrawn into the handle. The remaining portion of the instrument has not been contaminated. The anchoring sutures 1, 2 and 3 are drawn taut and tied, sealing the opening in the mucosa and submucosa.

ureter is tied to the carrier (Fig. 24 a and b). A longitudinal incision of the submucosal-mucosal layer, in length one and one-half times the diameter of the ureter, is made with an active electric

knife (without coagulation) in the apex of the triangular area marked out by the anchoring sutures (Fig. 26). The end of the ureter is pushed through this into the lumen of the bowel with the carrier, the end piece of which is detached in the bowel so that noth-

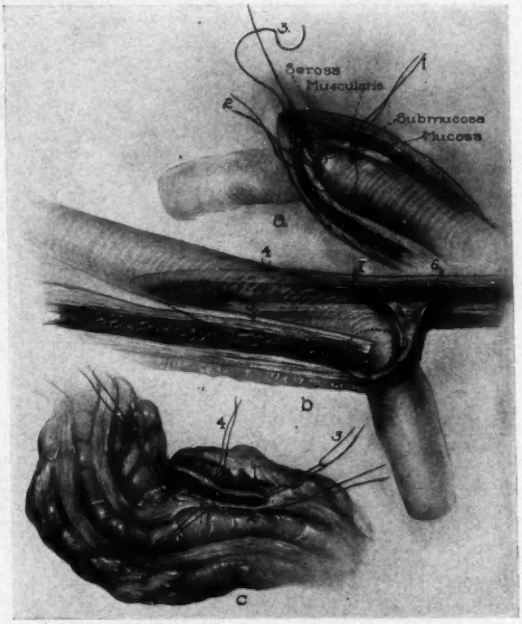

Fig. 28. Diagrammatic representation of the manner in which the ureter is anchored in the wall of the intestine by the five sutures.

a, Shows how the sutures, numbers 1, 2 and 3, anchor the ureter snugly in the small opening through the submucosa and mucosa made by the cautery and illustrates the reason this slit should not be too large but of a size, as indicated by the dotted circle, equal to the diameter of the ureter; *b*, represents the unconstricted anastomosis which is secured, and *c*, shows how the fourth and fifth sutures anchor the ureter in the trough of the incision.

ing is withdrawn and there is no chance for contamination of the wound (Fig. 27). The three anchoring sutures when tied seal the opening (Fig. 28). The muscular layers of the bowel are brought together over the ureter in its submucosal channel and the

site of implantation is covered with the flap of peritoneum left after isolation of the ureter. The abdomen is closed without drainage.

j. The Aseptic Submucosal Transplant Using an Electric Snare Through the Rectum.—Foley, in 1936,* suggested a method whereby a strictly aseptic submucosal transplant can be accomplished by the use of an electric snare. The snare consists of a rigid tungsten wire in the form of a ring which can be moved over a perforation in a hard rubber carrier which is of sufficient length to be manipulated through the anus. Following mobilization, division and ligation of the ureter, a longitudinal incision down

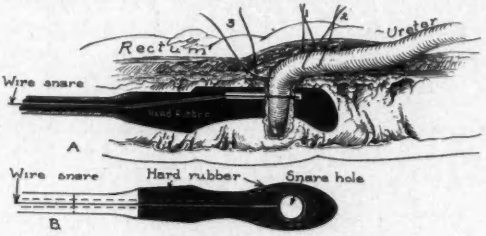

Fig. 29. Ninth Principle. Foley's aseptic submucosal transplant by use of an electric snare.

A. Ureter implanted submucosally; end of ureter with tent of mucosa and submucosa grasped by electric snare introduced through anus. Sutures 1, 2 and 3 placed between adventitia of the ureter and submucosa of the bowel. *B.* View of electric snare from above.

to the submucosa is made in the sigmoid. The snare which has been inserted by an assistant and can be felt easily through the rectal wall by the surgeon is held beneath the lower end of the incision with the opening in the snare corresponding in position to the lower angle of the exposed submucosa. The ligated end of the ureter is grasped with smooth tissue forceps and introduced into the opening in the snare carrying before it a small invaginated tent of submucosa (Fig. 29). A locking device at the proximal end of the snare is released by the assistant and the rigid wire ring is withdrawn until it grips securely the ligated end of ureter with its covering of submucosa. Upon removal of the forceps the security of the grip is made certain and then fixed by the locking device at the proximal end. The ureter is now implanted submucosally by sutures similar to those employed in Hinman's tech-

*Personal communication.

TABLE X. THE SUBMUCOSAL PRINCIPLE (VALVE ACTION)*

The Ninth Surgical Principle

Condition		I. Congenital Anomalies and Trauma			II. Vesical Infection (Ulcer)			III. Malignancy			IV. Not Stated			Total		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Number of Cases		47	19	58	9		10	34	3	73	1		5	91	22	146
Deaths: Surgical	S	6	1	12	1		2	15	1	37			3	22	2	54
Late	L	2		6	2			8		15				12		21
Causes: Shock	S	1		2.5				3		4			1			
	L															
Pneumonia	S							2		4						
	L	1		0.5	1											
Urinary Infections	S	1		3.5				5	0.5	14			2			
	L	1		0.5	1					1						
Urinary Obstruction	S	1		2				1.5		5						
	L			3						1						
Peritonitis	S	1.5		2.5	1		1	0.5	0.5	6.5						
	L			1												
Bowel Obstruction	S	1.5		0.5												
	L															
Not Stated	S		1	1			1	3		8						
	L			1				8		13						
Total Deaths		8	1	18	3		2	23	1	52	0		3	111		

Summary: 259 cases, 111 deaths

*For the purpose of analysis all intraperitoneal submucosal transplants without the use of catheters have been grouped under 1. These cases include divisions a, b, c, f, g and i in the classification.

Extraperitoneal transplants without the use of catheters are grouped under 2. (Division e).

All submucosal transplants by the use of catheters are grouped under 3. (Divisions e and g.)

Cases by Coffey's technic No. 3 (division h) have been analyzed under the first principle.

nic. Amputation of the end of ureter with its covering of submucosa is accomplished with the high frequency current at any time after operation selected by the surgeon.

A unilateral transplant by this method was executed by Foley in a case of carcinoma of the urethra. The convalescence was satisfactory until one month after operation when the patient died of lobar pneumonia. At necropsy the implanted kidney and ureter and the ureterosigmoidal orifice were found to be normal. There was, however, a small abscess between the ureter and muscularis at the upper end of the imbedded segment.

k. Aseptic Submucosal Transplant by Use of a Barb (Palmer, 1936).—Palmer's aseptic method of submucosal transplantation of the ureter will be discussed under the eleventh principle (Fig. 36).

Summary of Cases.—Two hundred and fifty-nine operations with the use of the submucosal principle resulted in seventy-eight early deaths, yielding a surgical mortality of 30 per cent. The complication of highest frequency was renal infection, occurring in seventy-three cases (28 per cent). Other common sequelæ to operation were peritonitis in twenty-two cases (9 per cent), urinary obstruction in twenty (8 per cent), the formation of fistulæ in twenty (8 per cent), and intestinal obstruction in eighteen (7 per cent). These cases are analyzed in Table X.

Discussion.—Undoubtedly the submucosal principle of ureterointestinal implantation is the most widely accepted at the present time and most closely approaches the normal route of the ureter into the cloaca in the fowl. The submucosa is the only layer of the bowel which will hold sutures satisfactorily. The chief virtue of the method lies in the firm union which can thus be formed between the ureter and bowel.

The importance which Coffey placed upon the principle of the formation of a valve is open to question. He claimed that, as a non-motile, movable gate which acts to prevent reflux, equally active in animate or inanimate mechanisms, the formation of a valve constituted the ideal junction for the entrance of the ureter into the bowel. The theory seems to lose significance when one considers the lack of synchronization between the peristaltic action of the ureteral musculature and that of the bowel, the persistence of the muscular ureteral walls up to the very uretero-intestinal

orifice, which often projects into the intestinal lumen as a muscular papilla, and the low pressure which exists in such a distendable structure as the rectum.

The use of approach tunnels tends to assure a firmer anastomosis. There is, however, difficulty in developing the proper plane of cleavage in the proper axis to the ureter, with resultant tearing of the muscularis and premature perforation of the mucosa as well as kinking of the ureter as frequent complications.

The simple aseptic method with a divisible carrier is to be recommended as being aseptic and as simplifying a technically complicated operation. When the sutures have been placed successfully, neither leakage afterward nor ureteral obstruction occurs.

Foley's procedure is fully aseptic during operation—more so than any one-stage technic so far devised. Infection, however, is to be feared subsequent to the wide exposure of the tissue spaces upon resecting the end of the ureter with its tent of submucosa; yet, if this resection is delayed until healing in of the ureter has occurred, the kidney will have been obstructed altogether too long.

The ten methods which have been grouped with the submucosal principle show so much variation that their analysis as a group is unjust. In spite of the high incidence of peritonitis and the formation of fistulæ in this group, individual series of cases by the submucosal method have been reported without the development of any of these complications. One is therefore led to believe that certain of the methods, when executed by experienced surgeons, effectively reduce the danger of leakage and peritonitis, and secure a minimum of late ureteral complications.

THE TENTH SURGICAL PRINCIPLE

Temporary Colostomy

a. For the purpose of direct inspection and treatment of the site of implantation (Barber, 1915).

b. Preliminary to implantation for the purpose of sterilization of the bowel and after implantation for the temporary diversion of the feces. (Nesbit, unpublished; Higgins, 1931.)

a. For Direct Inspection and Treatment.—In order to permit direct inspection of the site of uretero-intestinal anastomosis and to make possible the direct treatment of the ureters if complications arose, Barber, in 1915, presented an experimental method

which incorporated the first stage of a colostomy. The ureters, having been divided near the bladder, were made to penetrate the wall of the spur of colon at two points. Entering perpendicularly above, they were brought out at a point 90 degrees distant on the intestinal wall. The ureters were thus drawn through each wall, into the lumen of the gut and out again. The sigmoid was finally suspended in the wound by the usual glass rod method of colostomy and the ligated end of the ureter was attached to the nearby skin with a suture (Fig. 30).

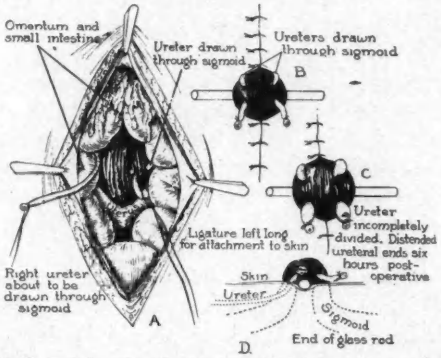

Fig. 30. Tenth Principle. Implanting ureters into a loop of sigmoid brought out on the abdominal wall by the method of Barber.

A. Ureters ligated and divided near the bladder. The left has been made to penetrate the entire wall of the sigmoid at two points. *B.* Spur of sigmoid brought out on abdominal wall over a glass rod, abdominal incision closed, ligated ureters passing in and out of the sigmoidal lumen. *C.* Six hours after operation an incision has been made in the end of the left ureter to release the urine. *D.* Sectional view of the spur of sigmoid and right ureter. (After Barber.)

Barber temporarily interrupted the urinary stream by deferring incision into the end of the ureter until six hours after operation. At any time after this, he stated, the ureter could be returned to the lumen of the bowel although he advised that it be maintained under control until its continued patency was assured. The operation, which could be executed in twenty minutes, was successful in seven of eight dogs.

b. For the Temporary Diversion of Feces.—Nesbit recently suggested* the principle of a temporary colostomy for the purpose of sterilization of the lower bowel by through and through irriga-

*Personal communication.

tion preliminary to ureteral implantation, the bowel opening to be used after implantation for the temporary diversion of feces. The same idea was applied by Higgins (September, 1931) in an experimental study on dogs. He made a permanent colostomy through which the lower segment of bowel was irrigated with boric acid and mercurochrome for one week before performing a bilateral uretero-intestinal implantation.

Discussion.—In considering Barber's method, it would seem that intestinal obstruction at the sigmoid spur would be a complication to be feared. There would be the possibility, too, of urine being dammed back into the upper large bowel instead of draining into the rectum. Other drawbacks are the temporary interruption of the urinary stream, the long extent of unprotected ureter which must be dissected from its bed to present outside the abdominal wall and the added magnitude of the operative procedure. These objections far outweigh whatever advantage might be gained from inspection and treatment of the site of anastomosis.

The Nesbit-Higgins principle of temporarily diverting the fecal current until healing of the site of anastomosis has occurred is worthy of consideration as a possible measure in avoiding ascending urinary infection. With tissue spaces, blood vessels and lymphatics completely sealed off, there should be less likelihood of this complication than if fecal matter were to come into contact with the operative site before healing was completely accomplished.

The results, however, of exclusion operations (discussed in detail in the first part of this paper), in which parts of the sigmoid or rectum have been partially or completely removed from the fecal current, have been most discouraging. There has been no reduction in the incidence of ascending urinary infection following their use. The important factor seems to be that it is impossible completely to sterilize the large bowel by any amount of through and through irrigation or other form of treatment. The few bacteria which always remain in the crypts of the mucosa are sufficient to multiply in the urine which enters the rectum as soon as a ureteral transplant has been performed. The urine then acts as an ideal culture media and produces a bowel content bacteriologically not markedly different from fecal matter itself.

No clinical cases in which the principle of temporary colostomy has been used have been reported.

THE ELEVENTH SURGICAL PRINCIPLE

The Use of the Intact Ureter; A Two-stage Operation

First Stage: A loop of ureter is isolated and an intact section is imbedded down to the submucosa beneath the muscular layers of the bowel. (Urine continues to drain into the bladder as usual.)

Second Stage: The lumina of the ureter and bowel are connected.

a. By a fulguration tip inserted through the proximal end of the ureter divided just below the point of its egress from the submucosal channel (Ferguson, 1931, experimental; Poth, 1935, experimental).

b. By insertion of the proximal end of the divided ureter into the lumen of the bowel through an opening made at the point of egress of the ureter from the submucosal channel (Ferguson, 1931, experimental; Winsbury-White, 1933; Nesbit, 1935).

c. By a transfixion suture placed at the first stage (Higgins, 1933).

d. By hair pin wires looped over and through the ureter (Brenizer, 1935).

e. By insertion of the end of the ureter by the use of a barb (Palmer, 1936, experimental).

The most recent principle to be developed makes use of the intact ureter which is implanted submucosally without interruption of the urinary stream. At a second stage the ureters are divided and a communication is established between the lumina of the ureters and bowel. Preparation for this short fistulous tract may have been made at the first operation, as by the transfixion suture (Higgins) or the hair pin wire (Brenizer). (The first surgical principle.)

a. By Fulguration.—Charles Ferguson (U. S. Public Health Service), in 1931, experimenting with cats and cadavers, was the first to use the intact ureter. At the first stage both ureters are implanted in an incision one and one-half inches long made in the wall of the sigmoid down to the submucosa. The muscularis is carefully dissected from the submucosa so that it can be reunited with mattress sutures over the transplanted ureters without compression. Flaps of peritoneum, which were raised in order to dissect the ureters from their beds, are used to close over the suture lines in the bowel. Ferguson warned against too great tension and angulation of the ureter.

At the second operation a short fistulous tract (the first principle) is produced with a fulgurating electrode (Fig. 31 A, B).

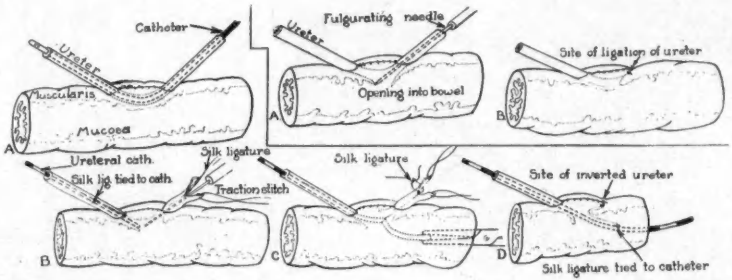

Fig. 31. Eleventh Principle. Use of the intact ureter, joining the lumina of the ureter and bowel by the fulguration method of C. Ferguson.

A. Fulgurating needle making an opening through the submucosa and mucosa, establishing a fistulous tract between the ureter and the bowel. *B.* Stump of ureter infolded in wall of bowel with mattress sutures. *A, B, C* and *D:* Method of executing operation with the use of a ureteral catheter. *A.* Short ureteral catheter introduced in submucosally implanted ureter. *B.* The catheter with a silk ligature attached well above the end is introduced up the ureter, beyond the point at which the opening into the bowel is to be made. The opening between the ureter and the bowel is made with the fulgurating needle. *C.* The distal end of the ureteral catheter is drawn back into the bowel through this fistulous tract by means of the silk ligature and the end is grasped with a clamp introduced through the anus. *D.* The end of the ureter is invaginated and the point of invagination is closed over with mattress sutures by the silk ligature attached to the catheter when it is withdrawn by the rectal clamp. (After Ferguson.)

The distal portion of the ureter is freed and excised below the point at which it leaves the bowel wall. The distal stump having been ligated near the bladder, the tip of a fulgurating electrode is introduced through the proximal end and, when it reaches the proper point, the current is turned on and a hole is cut into the bowel. The mucosa of the ureteral end may be destroyed by fulguration as the tip is withdrawn. Closure is effected by folding the stump into the wall of the bowel with mattress sutures. In cadavers Ferguson found it easy to introduce short ureteral catheters which he threaded up the ureters and out through the rectum (Fig. 31 A, B, C, D).

Poth, in 1935, using the principle of the intact ureter, proposed the following complicated procedure utilizing a proctoscope and a high resistance cautery wire. The first stage consists of a submucosal implantation of the ureters, using a continuous suture of Cushing No. 0 catgut placed in the submucosa for closure. Sufficient tissue is included to approximate 3 mm. of serosa on either side. Kinking and compression of the ureters are prevented by leaving 0.2 cm. of submucosa at either end of the trough. No attempt is made to extraperitonealize the implant.

At the second operation three weeks later the ureters are divided at a convenient distance below their emergence from the bowel. A proctoscope is introduced into the rectum until the end is at the distal point of the ureter in the bowel. An opening is made in the ureter 2 cm. from its point of egress from the bowel and the needle, attached to an end of the resistance wire, is introduced into the ureter. Using the edge of the proctoscope as a fulcrum, the needle is rotated so as to invert the wall of the gut, the buried ureter and the needle into the open end of the proctoscope. The point of the needle is thrust through the visceral walls and grasped by an assistant using alligator forceps through the proctoscope. The needle is drawn out until about half the length of resistance wire is pulled through. Another needle, at the other end of the resistance wire is thrust through both walls, a short distance above the first and in a similar manner is drawn out through the proctoscope by the assistant. All the slack in the resistance wire having been taken up by the assistant, the ends of the wire in the proctoscope are protected with glass shields. When the current is turned on, the noninsulated loop of the wire cuts

a fistulous tract through the ureteral and intestinal walls. The adjacent wall of the ureter is protected during cutting by a ureteral catheter. Cauterization has been found to require as long as 15 seconds. The wire should be examined subsequently to make certain that it is intact, as it may break and fail to form an opening. The ureteral catheters are withdrawn through the proctoscope by

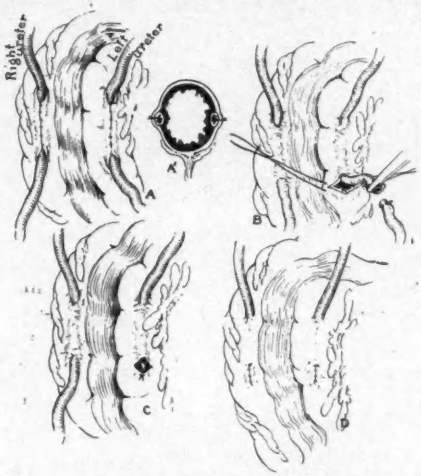

Fig. 32. Eleventh Principle. Winsbury-White's use of the intact ureter. At the second stage, the proximal end of the ureter is implanted into the bowel through a longitudinal incision.

A. Submucosal implantation of the ureters in the wall of the bowel. *A*.[1] Sectional view. *B*. The ureter is divided three-fourths of an inch below its egress from the submucosal channel, at which point a longitudinal incision into the bowel is made. *C*. The end of the ureter is inserted into this opening and fixed in place with an anchoring suture. *D*. Completion of the operation—both ureters transplanted and the incisions in the bowel closed. (After Winsbury-White.)

the assistant in order to prevent contamination. After the ureterointestinal communication has been established and the catheter removed, the distal segment of the ureter is divided close to the bowel and ligated, the end is buried and the area closed with a single suture in the colon.

b. By Insertion of the End of the Ureter into the Bowel.—Instead of using the fulgurating tip, Ferguson, in his experimental work with cats, in 1931, sometimes found it more convenient to insert the end of the ureter, threaded on a probe, into the lumen

of the bowel through a small puncture made at the end of the submucosal channel.

Winsbury-White, in 1933, presented his two- or three-stage method of using the intact ureter (Fig. 32). At the first operation one or both ureters are implanted in an incision 1 inch in length made down to the submucosa. The muscular wall is dis-

Fig. 33. Eleventh Principle. Nesbit's use of the intact ureter. At the second stage, the proximal end of the divided ureter is implanted into the bowel through a stab wound which is closed by a purse-string suture.

A. First stage. Submucosal implantation of the ureters. *B.* Second stage. The ureters are divided one inch distal to the area of implantation, a pursestring suture is laid on either side at the point of egress of the ureter from the submucosal channel and inside of this the wall of the bowel is punctured, as shown on the left side. *C.* The end of the left ureter has been pushed into the bowel through this puncture wound and the end of the right ureter is being introduced similarly. *D.* The left purse-string suture closing in the site of implantation has been tied and the right is about to be tied. (After Nesbit.)

sected free to permit resuture over the ureters without tension, and closure is effected with a continuous catgut suture.

Two weeks later the ureter is divided between clamps about three-fourths of an inch below the distal limit of the union with the bowel. The proximal end is transfixed with a catgut suture and the distal end ligated. Two traction sutures are placed in the wall of the bowel on either side of the lower end of the implant

and an incision one-half inch long is made longitudinally along the line of the ureter into the lumen of the bowel. The ureter having been dissected free and its lower end split for a distance of one-fourth of an inch, it is anchored within the lumen of the gut by the suture previously placed. This suture transfixes the intestinal wall from within outward, and brings the end of the ureter below the lower margin of the incision. The incision in

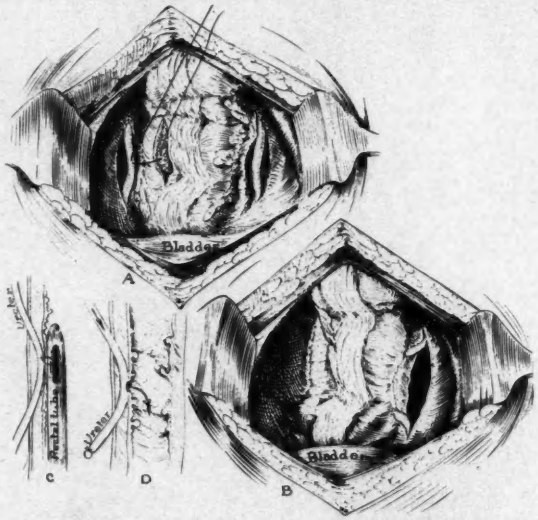

Fig. 34. Eleventh Principle. Higgins' use of the intact ureter with Coffey's transfixion suture.

A. Both ureters have been isolated. The incision of the bowel down to the submucosa has been made on the right and the transfixion suture has been placed ready to tie. *B.* Bilateral implantation of the intact ureters has been completed and the peritoneum has been closed on the right. *C.* Sectional view showing transfixion suture piercing rectal tube. *D.* Sectional view after the transfixion suture has sloughed out establishing a fistulous tract between the ureter and bowel. (After Higgins.)

the wall of the bowel is repaired with a line of continuous catgut reinforced with Lembert sutures.

In his first case Winsbury-White performed the operation in three stages. At the first stage he embedded the left ureter, at the second he inserted the left ureter into the bowel and embedded the right, and at the final operation he inserted the right ureter into the bowel. He suggests, however, that the operation may be performed in two stages, treating both ureters at each operation.

Winsbury-White reported one case, that of a girl thirteen years of age suffering from hypospadias, who recovered from a three-stage operation by his method.

Nesbit, in 1935, presented his two-stage method of transplanting the intact ureters (Fig. 33). At the first operation both ureters are mobilized for a distance of 10 cm. at the level of the pelvic brim and imbedded between the muscularis and serosa of the upper rectum.

From fourteen to twenty-one days later, at the second operation, the ureters are divided 1 inch distal to the area of implantation. A pursestring suture is then laid in the intestinal wall around the base of the severed ureter and a puncture wound made into the lumen of the intestine as closely as possible to the ureteral stump. The anastomosis is completed by inserting the end of the ureter into the lumen of the bowel and firmly tying the purse-string suture. Nesbit performed this operation on two patients suffering from malignancy. Neither has been followed for a sufficient period to evaluate the end results.

c. By a Transfixion Suture.—Higgins, in September of 1933, described a method which combines the transfixion suture of Coffey with the principle of the intact ureter (Fig. 34). In the first stage, an incision 6.5 cm. in length is made in the rectosigmoid down to the mucosa. The ureter having been placed in the trough, a transfixion suture of silk is placed first through the wall of the ureter, piercing its lumen, and then through the exposed submucosal-mucosal layer of the rectal wall and tightly tied. It may be anchored on a rectal tube or on a ring as proposed by Coffey. Higgins advises that it is essential for the suture to be placed at the distal end of the incision in order to obviate the formation of a blind pouch when the ureter is severed at the second stage. (Ferguson avoided this by destroying the mucosa of the ureter by fulguration.) The muscular and serous layers are reapproximated over the ureter with interrupted silk sutures. The site of implantation is finally extraperitonealized with a flap of posterior parietal peritoneum.

At the second operation, the ureters are isolated, divided and ligated as closely as possible to their point of emergence from the distal angle of the incision and the end is buried in the wall of the bowel.

d. By Hairpin Wires Looped Over and Through the Ureter.—Brenizer, in 1935, developed a technic of submucosal implantation of the intact ureters by which a communication between the ureters and bowel could be established later without an additional abdominal operation (Fig. 35).

A rectal tube is inserted and a transperitoneal exposure made. Both ureters are isolated without division and the two longitudinal incisions are made in the rectosigmoid through the serosa and

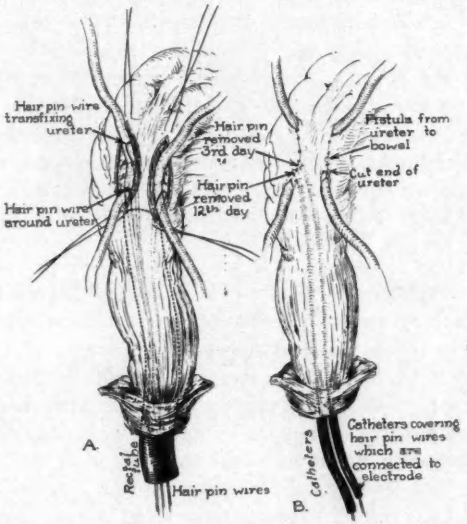

Fig. 35. Eleventh Principle. Hairpin wire method of Brenizer.

A. Relationship of hairpin wires to ureter in its submucosal course. Wires passing through submucosa and mucosa and out rectal tube. *B*. Anastomosis completed. Serosa and muscularis closed over ureters, hairpin wires in place on right, following removal on left.

muscularis down to the submucosa as in all first stage operations by the eleventh principle. Two lengths of tonsil wire, bent in the shape of long hairpins are placed one just above the other as follows, the longer being designated as the loop, and the shorter as the transfixion wires. The right ureter is laid in its submucosal channel and an end of the loop wire is passed on each side of it through the submucosa and mucosa at the distal end of the incision into the open end of the rectal tube in which the two

ends of the wire are seized by an assistant who draws them on out together until the loop engages the ureter. These are the longer "loop wires." The end of another piece of wire is made to pierce the wall of the ureter just above the level of this loop wire, is passed a short distance up the lumen of the ureter and then out through the wall again and the two ends of this transfixion wire are passed through the submucosal-mucosal layer into the open end of the rectal tube and drawn out together by an assistant until the wire engages the wall of the ureter.

The rectal tube is then removed, reintroduced alongside the four wires and the same procedure carried out upon the left ureter. The muscularis and serosa are closed over the ureters. The lower ends of the loop and transfixion wires of the right and left sides are bent by an assistant for identification and attached to slight elastic traction.

After three days, with the aid of a proctoscope, a small rectal tube is passed over the four transfixion wires as insulation and the right and left wires are touched in succession with an electrocoagulation electrode causing them to cut through, thus forming a short fistulous tract between the ureter and the bowel (first surgical principle).

After twelve days, gentle traction is applied to the loop wires in an attempt to draw the ureter down so that when cut the ends of the ureter will project into the lumen of the bowel. To do this a weak electric current is passed through first the right loop and then the left loop so as to cut slowly through the ureters and rectal submucosa and mucosa, coagulating the contiguous tissues. The method was successful in one clinical case.

e. Insertion of End of Ureter by Use of a Barb.—Palmer, in 1936,* experimenting on dogs, developed a method whereby the end of the submucosally implanted ureter is introduced aseptically into the lumen of the bowel at a second stage operation (Fig. 36). At the first stage the ureters are implanted submucosally as usual. About two weeks later the site of implantation is exposed and the distal portion of the ureter dissected free to about the mid portion of its submucosal course. It is divided some 5 cm. farther down. The end is now split for a distance of about 1 cm. and one corner of the divided end is ligated with a suture of No. 1

*Personal communication.

plain catgut. The short end of this suture is inserted up the ureter, as advised by Mayo, for a urine guide. The long end is threaded through a barb which is used to pierce the mucosa and submucosa of the bowel. There are right and left barbs, one for each ureter, which are made with longitudinal grooves along the side for the reception of the ureter. The ureter having been pulled down snugly into the groove of the barb by making traction on the long end

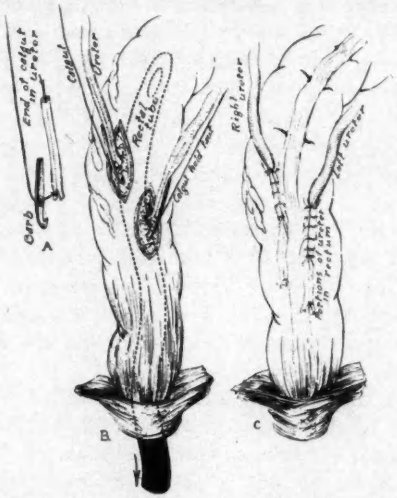

Fig. 36. Ninth (and Eleventh) Principle. Submucosal implantation of ureter by method of Palmer using a barb.

A. End of divided ureter attached to barb. Short end of catgut threaded up ureter as urine guide. *B*. Rectal tube in place, incisions made down to submucosa. Barbs with ureters attached piercing submucosa, mucosa and rectal tube. *C*. Rectal tube withdrawn, bringing ends of ureters within bowel. Serosa and muscularis closed over submucosally implanted ureters.

Note: This illustration shows the operation being performed using the ninth principle alone, a method which Palmer recommends, as well as with the intact ureter. The end of the ureter is treated in an identical manner in both operations.

of catgut, the blunt end of the barb is grasped firmly with a needle carrier and the barbed sharp end is thrust through the submucosa and mucosa of the bowel into the wall of a rectal tube which has been previously introduced through the anus. Upon withdrawing the rectal tube, the barb catches in the rubber wall of the tube and is pulled into the lumen of the bowel, carrying the end of the ureter with it. Keeping the long end of catgut taut, sutures are

now placed through the serosa and muscularis of the bowel completely closing the site of implantation. The long end of catgut, traction on which has held the end of the ureter in the barb, is dropped, the excess cut off, and as the rectal tube is withdrawn it disappears into the bowel.

The identical procedure is carried out on the opposite ureter, using the other barb.

Palmer also recommends that the operation be performed in one stage, making use of the ninth principle alone.

Summary of Cases.—Methods utilizing the principle of the intact ureter with transfixion suture are of such recent origin that very few case reports are available. Higgins, in one of his reports in 1935, mentions knowing of fifty-three patients operated on by various surgeons according to his technic with only four deaths. No reports are available which will permit a statistical analysis of complications, causes of death or late results.

Discussion.—As Ferguson originally pointed out, the submucosal implantation of the intact ureter, with postponement of urinary diversion to a second operation, permits aseptic healing of the ureter in its new channel in the wall of the bowel. Cut surfaces are not exposed to contamination with urine and feces. The advantages of the method are reduction of the danger of leakage at the site of anastomosis; elimination of the evils of obstruction from the surgical edema during the period of healing; and lessening of the opportunity for the development of ascending urinary infection by the postponement of exposure of the lymphatics, blood vessels, tissue spaces and lumen of the lower ureter to contamination until after the initial wound has healed. Winsbury-White also suggests that the procedure more adequately preserves the vitality of the lower ureter at the site of implant, thus lessening the possibility of gangrene which might arise from a poor blood supply before a proper collateral circulation had begun to function.

Urinary obstruction has followed the first stage of the operation because of constriction of the imbedded portion of ureter, stretching or too much slack, either of which may produce angulation. Occasionally at the second stage a ureter has been found to have torn loose from its channel in the bowel.

Higgins' procedure is an advance over Coffey's original method with a transfixion suture in that there is no interruption of the

urinary stream. It fails equally, however, of strict asepsis because of the transfixion suture. With an early development of a fistulous tract, too, there is more danger of infection and leakage at the site of anastomosis than in methods permitting complete healing prior to the production of a fistula.

Of the five methods devised for insertion of the end of the ureter into the lumen of the bowel at the second operation, Winsbury-White's is the most extensive procedure. Dissection down to the submucosal bed and the placing of an anchoring suture open a wide expanse of tissue spaces and cause more trauma than a more simple insertion. There is greater opportunity, therefore, for contamination, infection and leakage. Palmer's technic with a barb provides an aseptic insertion. The insertion by puncture, however, unless the barb were of sufficient diameter to provide a loose opening, might cause constriction of the ureter. The technic of Brenizer eliminates a second abdominal operation but the highly technical steps of establishing an opening from ureter to bowel are poorly controlled and blindly executed and the perforation of the intestinal wall by the wire hairpin at the first stage opens up routes for the spread of infection, as does any transfixion suture.

Temporary urinary obstruction from edema of the newly made orifice may take place following the second stage. Such edema may be a sequel to coagulation or secondary to trauma incurred during the insertion of the end of the ureter into the bowel. Late urinary obstruction at the site of anastomosis, as has been noted in older methods, may arise, by this method also, from cicatrization of the fistulous tract or from inflammatory constriction of the implanted ureters. As already stated, a side opening or slit in the ureter is not likely to be so permanently patent and satisfactory as an end opening.

The surgical principle of the intact ureter marks a distinct advance in theory. Its worth and place in uretero-intestinal implantation await the test of practice. Certainly its most useful application will be in conjunction with one or more other principles.

GENERAL SUMMARY

A study has been made of the different methods used to implant the ureters into the intact intestinal tract, and of the results obtained.

More than sixty surgical technics, many of which are modifications of an original principle, have been published by some fifty-odd surgeons. Each proposal, no doubt, seemed to the surgeon at the time to be new and practical or to offer some particular advantage over previous methods because of a new principle or the use of an old one in a new way.

In this summary, we have disregarded the one-stage operation, as opposed to that done in two stages (one ureter at each operation), and the intraperitoneal versus the extraperitoneal method of approach, either of which would duplicate the list of technics.

The various technics can be classified as elementary or compounded of two or more of eleven surgical principles for the establishment of a communication between the ureter and bowel. These principles, in the chronological order of their proposal, are:

1. The formation of a fistulous tract.
2. The direct (axial) implantation with or without exact apposition of mucosa to mucosa.
3. The formation of a muscular channel from the wall of the intestine, the muscularizing principle.
4. The preservation of the ureteral orifice (and its valve).
5. The temporary diversion of the urine (always used in conjunction with one of the other principles).
6. The formation of a valve from an internal flap of the intestinal wall.
7. The use of mechanical devices.
8. Insertion into the tip of the appendix (a natural duct).
9. The submucosal principle.
10. Colostomy for temporary diversion of the fecal stream (always used in conjunction with another principle) or for purposes of inspection.
11. The use of the intact ureter.

The results in 740 patients with uretero-intestinal implantations (unclassified) show an operative mortality of 30 per cent (229 deaths).

Four hundred and ninety of the 740 patients had exstrophy, vesico-vaginal fistula or an incurable vesical ulcer or infection, 203 had cancer (of the urethra, vagina, bladder, prostate, et cetera), and the diagnosis was not stated in forty-seven. The surgical mortality by all methods in the first group was 20 per cent; in the second, over 50 per cent. Many of the deaths in the group of patients with malignancy followed the second stage of surgery for removal of the cancer (cystectomy, prostatectomy, et cetera).

Three surgical principles have been used widely, the others in relatively few patients. The muscularizing principle (third) has been applied in 136 patients, with a surgical mortality of 27.9 per cent; the preservation of the ureteral orifices (fourth principle) in 243 patients with a surgical mortality of 27.6 per cent, and the submucosal principle (ninth) in 259 patients, with a surgical mortality of 30.1 per cent.

When the patients are separated into two groups—those with benign and those with malignant lesions, the surgical mortalities are respectively:

Submucosal				Muscularizing				Maydl		
Benign		Malignant		Benign		Malignant		Benign		Malignant
No. of Patients	%	No. of Patients	%	No. of Patients	%	No. of Patients	%	No. of Patients	%	
143	15.5	110	48.2	92	19.5	44	45.4	243	27.6	Not applicable

The common complications of uretero-intestinal implantations follow intestinal and urinary infections and obstructions. These may become serious immediately following operation or not be troublesome for months or years afterward.

The reports are too incomplete to determine from them the late results either as a whole or those achieved by any particular principle or technic. Occasionally ureters have been implanted successfully by each of the eleven principles except the sixth and the tenth.

Early complications were numerous although undoubtedly they were incompletely reported. Peritonitis occurred in eighty-two (twenty-two of 136 patients operated on by the muscularizing principle; twenty-four of 178 patients by the Maydl, and twenty-two of 259 by the submucosal). Intestinal obstruction occurred in twenty-four (none reported by the use of the Maydl principle, four by the muscularizing, eighteen by the submucosal, and only two by the other principles. These statistics are obviously unreliable except possibly those for the submucosal principle).

Urinary and fecal fistulæ or both were reported in seventy-two of the 740 patients (five by the muscularizing principle, seventeen by the Maydl, and twenty by the submucosal).

Two hundred and twelve of the 740 patients, or 28.6 per cent, had early renal infections (by the muscularizing principle, forty-nine of 136 patients; by the Maydl, forty-three of 178 patients; and by the submucosal, seventy-three of 259 patients). Ureteral obstruction was indicated as a complication in only fifty-four of the 740 patients (eight by the muscularizing principle, eight by the Maydl, and twenty by the submucosal).

GENERAL DISCUSSION

A study of the literature on uretero-intestinal implantation, as just summarized, leaves one with a feeling of disappointment at the lack of improvement with the advent of newer methods and greater experience. It would seem that every surgical principle imaginable has been tried. Of the eleven listed, the submucosal principle has a distinct advantage in theory and has shown the best results in practice. Nearly all modern technics make use of it either as the primary or secondary principle. Even the newest methods which utilize the intact ureter (eleventh principle) with the idea of asepsis are primarily submucosal. The problem of the formation of an opening between the ureter and the bowel at the second stage of the operation, by methods based on the eleventh principle, has not been satisfactorily solved. The final test of a successful implantation is not only recovery from the operation, but survival with normal ureters and kidneys. The lateral opening of those technics using it is unsatisfactory because of its tendency to constrict and produce obstruction. In practice, the advantage gained by the healing of the ureter in its intestinal channel under conditions of asepsis is offset by the difficulties of establishing a full opening afterward. Simpler one-stage methods which give an orifice at the end of the ureter may prove superior.

In addition to these elementary principles of surgery representing the eleven major differences in technic, several conditions must be recognized as common to all technics, no matter how elementary or compound. These are the basic principles of intestinal and ureteral surgery and must be fulfilled by any method. What produces localized necrosis of the intestine or perforation and tearing out of sutures, the common causes of postoperative leakage and peritonitis? What produces the constriction which leads to intestinal obstruction? Why is anemic infarction, extensive necrosis,

TABLE XI. SUMMARY OF INCIDENCE OF COMPLICATIONS

	1. The Formation of a Fistulous Tract:						2. Direct		3. Muscularizing		4. Preservation of Ureterovesical Orifice			
	(a)		(c1)		(c3)						a		b	
Number of Cases	2		11		3		37		136		178		65	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Renal Infection	1	50.	2	18.	1	33.	8	21.6	49	36.0	43	24.2	22	33.8
Urinary Obstruction	1	50.	2	18.	1	33.	5	13.5	8	5.9	8	4.5	5	7.7
Peritonitis	2	100.	1	9.	1	33.	2	5.4	22	16.2	24	12.5	3	4.6
Intestinal Obstruction							2	5.4	4	2.9				
Fistulae (urinary, fecal, or both)			2	18.	1	33.	5	13.5	5	3.6	17	9.6	14	21.5
Pneumonia							1	2.7	4	2.9	9	5.0	1	1.5
Shock							1	2.7	2	1.5	3	1.7	1	1.5
Wound Infection					1	33.	2	5.4	4	2.9	1	0.6	3	4.6
Urinary Calculi	1	50.							2	1.5	3	1.7	1	1.5
Wound Disruption									4	2.9				
Cardiac Failure									2	1.5	1	0.6		
Septicemia									1	0.7	2	1.1		
Phlebitis							1	2.7					1	1.5
Colitis							1	2.7	2	1.5				
Pulmonary Embolus													1	1.5
Parotitis									1	0.7	1	0.6		
Bowel Hemorrhage									1	0.7	1	0.6		
Septic Dermatitis									1	0.7			1	1.5
Status lymphaticus											1	0.6		
Scarlatina											1	0.6		
Meningitis											1	0.6		
Influenza													1	1.5
Massive Collapse of Lung									1	0.7				
Empyema														
Bacterial Endocarditis														

NOTE: The cases in which the principle of temporary diversion of the urine has been applied (Principle 5) have been analyzed under the more fundamental principle with which it has been combined. No clinical cases have been reported by the principle of temporary diversion of the fecal stream (Principle 10). There is not sufficient data reported to list complications by the method of the intact ureter (Principle 11).

Subheads refer to methods as follows:

1. The formation of a fistulous tract.
   a. By use of a long suture from ureter to bowel (Simon).
   c, 1. The transfixion suture with submucosal implantation (Coffey's third technic).
   c, 3. The submucosal transfixion suture technic in combination with temporary drainage by ureterostomy (Hinman).

IN 740 CASES OF URETERO-INTESTINAL ANASTOMOSIS

6. Flap Principle		7. Mechanical Devices		8. Natural Duct		9. Submucosal						12. Miscellaneous				Total	
						(1)		(2)		(3)		a		b			
4		13		10		91		22		146		10		12		740	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	25.0	4	30.8	2	20.0	28	30.7	2	9.0	43	29.4	3	30.0	3	25.0	212	28.6
				2	20.0	2	2.2	3	13.6	15	10.3	2	20.0			54	7.3
		2	15.4	2	20.0	5	5.5			17	11.6			1	8.3	82	11.1
						7	7.7			11	7.5					24	3.2
		2	15.4	1	10.0	6	6.6	4	18.1	10	6.8	5	50.0			72	9.7
				1	10.0	7	7.7			5	3.4					28	3.8
1	25.0	1	7.7			2	2.2			7	4.8			1	8.3	19	2.6
						4	4.4			2	1.3					17	2.3
										4	2.7					11	1.5
						2	2.2			2	1.3					8	1.1
						1	1.1							2	16.66	6	0.8
		1	7.7													4	0.5
										2	1.3					4	0.5
										1	0.7					4	0.5
						1	1.1			1	0.7					3	0.4
										1	0.7					3	0.4
																2	0.3
																2	0.3
																1	0.1
																1	0.1
																1	0.1
																1	0.1
																1	0.1
										1	0.7					1	0.1
										1	0.7					1	0.1

4. Preservation of ureterovesical orifice.
   a. Trigonal implantations (Maydl).
   b. Separate implantation of orifices with rosette of vesical mucous membrane (Bergenhem).
9. The submucosal principle.
   (1) Intraperitoneal submucosal transplant (Coffey's first technic).
   (2) Extraperitoneal submucosal transplant (Cabot).
   (3) Submucosal transplant by the use of ureteral catheters (Coffey's second technic).
12. Miscellaneous.
   a. Combination of methods.
   b. Method not stated.

TABLE XII. SURGICAL MORTALITY IN 740 CASES OF URETERO-INTESTINAL ANASTOMOSIS

Surgical Principle	I. Congenital Anomalies and Trauma			II. Vesical Infection (Ulcer)			III. Malignancy			IV. Diagnosis Not Stated			Total		
	Cases	Deaths	Mortality %	Cases	Deaths	Mortality %	Cases	Deaths	Mortality %	Cases	Deaths	Mortality %	Cases	Deaths	Mortality %
1. Fistulous tract	7	1	14.3	1	0	0	5	3	60.0	3	0	0	16	4	25.0
2. Direct insertion	17	3	17.6	3	2	66.6	15	9	60.0	2	2	100.0	37	16	43.2
3. Muscularizing principle	89	17	19.1	3	1	33.3	44	20	45.4				136	38	27.9
4. Preservation of ureteral orifice	205	48	23.4	3	1	33.3	4	1	25.0	31	17	54.8	243	67	27.6
5. Temporary diversion of urine	(Analyzed under another principle used in conjunction)														
6. Internal flap of bowel	2	1	50.0				1	1	100.0	1	1	100.0	4	3	75.0
7. Mechanical devices	3	0	0	2	1	50.0	8	6	75.0				13	7	54.0
8. Insertion in natural duct	5	2	40.0	1	0	0	3	3	100.0	1	1	100.0	10	6	60.0
9. Submucosal	124	19	15.3	19	3	15.8	110	53	48.2	6	3	50.0	259	78	30.1
10. Temporary diversion of the fecal stream	(No clinical reports)														
11. Intact ureter	(Reports too incomplete to analyze)														
12. Unclassified	3	1	33.3	3	1	33.3	13	7	53.8	3	1	33.3	22	10	45.4
Total	455	92	20.2	35	9	25.7	203	103	50.7	47	25	53.1	740	229	30.9

diffuse ureteritis or marked dilatation of the ureter found at autopsy? Too often the answer is—failure to follow the simple well known rules of intestinal and ureteral surgery. The only layers which are safe for suturing are the submucosal layer of the bowel and the adventitia of the ureter. Sutures cannot penetrate the lumen of either without danger. Their blood supply cannot be disturbed to any great extent. Neither one can be unduly traumatized, twisted nor displaced. These are some of the basic principles that must be followed.

The marked difference between the risk of implantation for exstrophy (less than 15 per cent) and for cancer (almost 50 per cent) arises partly from differences in the age period but mostly from the added risk of the surgery for the malignant condition. Statistics show too that implantations in two stages (one ureter at each), as done for most exstrophies, are safer than simultaneous bilateral implantations. The latter is the usual method used in malignancies because of the necessity for a second operation to remove the cancer. Perfection of the principle of the intact ureter to a one-stage operation, or the development of any safe procedure in one stage will lower the mortality of cystectomy for malignancy. Until such a procedure is developed, the implantation of the second ureter at the time of cystectomy is the safest plan.

The theoretical advantage of extraperitoneal operations has not proved to be practical. Peritonitis results from leakage after operation and not from contamination at the time. When sutures are placed properly leakage does not occur. The little protection against it gained by extraperitoneal exposure is more than offset by the increased difficulty of implanting the ureter untwisted, unkinked and unobstructed.

Finally, it appears from this study that the problem remains unsolved and, in making this admission, one must recognize that the problem involved is not solely one of surgical technic. There is the unknown, indeterminate, but ever-present factor of urinary sepsis. Susceptibility to infection varies with individuals as does the conjunction at operation of accessory and other factors which favor it. Often varying degrees of pyelonephritis and infected hydronephrosis are present already and experience shows that such conditions are rather favorable than otherwise when they have led to a well established immunity. Whether the tract above is clean

or not, there is the chance that an acute infection will ascend from the bowel to the kidneys as soon as a communication is established. The surgeon who knows the individualistic, technical and bacteriological factors of success and failure is in a position to reduce the uncertainty of the operation to a minimum. The success of the future may lie along lines of immunity as much as of technic.

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URETERO-INTESTINAL IMPLANTATION BY AN ASEPTIC METHOD WITH A DIVISIBLE CARRIER

A MODIFICATION OF THE SIMPLE SEVEN SUTURE METHOD WITH PROBE AND CAUTERY.*

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Clinical trial in sixteen patients (twelve reported*) and experimental investigation in more than two score of dogs† proved the simple seven suture method of uretero-intestinal implantation, with probe and cautery, to have three possible objections:

First: The contamination of the operative wound upon withdrawal of the probe used to insert the end of the ureter into the bowel may be enough to cause trouble (periureteritis, local abscess).

Secondly: The lateral orifice (slit in the ureter) above the ligated end of the ureter hanging free in the bowel may not give as wide an outlet for urine as would the orifice at the end. The contingent stasis and possible interference with ureteral peristalsis favor infection.

Thirdly: Sometimes the submucosal floor on which the ureter rests may be left too open and unprotected so that a slight mucosal-submucosal herniation occurs. In this event, the object of the method, namely, that the ureter enter free and unobstructed, is defeated.

The following modification of technic removes these objections:

The preparation of the patient for operation (the spinal anesthetic,‡ the abdominal incision, the packing off of the intestines, the preparation of the flaps of peritoneum, and the isolation of the ureters from beneath these flaps) is carried out as has been described previously.§

*The experimental work on dogs, in which Drs. Weyrauch, Fernald and Peterfy assisted, supported by the Christine Breon Fund of Hooper Foundation for Medical Research will be reported elswhere.

†An Experimental Study of Uretero-intestinal Implantation. I. The Cause of Peritonitis. Surg., Gyn. and Obs., 62:909-917, 1936.

‡A combination of a solution of 2 c.c. of pantocaine hydrochloride (20 milligrams) and of 50 milligrams of neocaine is given with the patient in the sitting position, maintained for five minutes after injection to allow the pantocaine, which is heavier than spinal fluid, to gravitate downward.

§A Simple Seven Suture Method of Bilateral Uretero-intestinal Implantation, Report of twelve Cases. Surg., Gyn. and Obs., 61:802-815, (December) 1935.

Generally, in case of ureters which are normal or appear to be so, the left can be implanted first at the higher level, to the advantage of surgical technic. When one or both ureters are dilated the problem may be difficult. The condition of the walls of the ureters and the relative renal function and potentiality for repair should be known before operation. The advisability of preliminary nephrostomy should have been considered in all cases of hydronephrosis of any degree. Ureteral catheterization, however, may have been impossible and excretory urograms may have failed to demonstrate the true condition. The decision then must be made at operation. Successful implantation of large hydro-ureters, the walls of which are as thin as tissue paper, is well nigh impossible, though it might be accomplished occasionally by the older technic of Coffey-Mayo, with a transintestinal anchoring suture. When the dilated ureter has thick walls, however, the technical difficulties are diminished. Implantation is even easier than with normal ureters, and these patients do very well as a rule. For these reasons, when one has to decide, at operation, on which side to operate first, when one ureter is dilated and the other normal, decision should be based on more than the theoretical points of counterbalance. Should the hydronephrotic side be capable, as proved by retention catheter or nephrostomy tube, of carrying total function at need, the law of renal counterbalance indicates the advisability of the implantation of the hydro-ureter first. On the other hand, should it have been proved that the hydronephrosis is incapable of so much repair, there need be no hesitation in the implantation of the good ureter, with the idea in mind of a hydronephrectomy later. In this connection, however, the surgeon must consider also the relative thinness or thickness of the wall of the hydroureter in relation to the method of implantation to be used, the age and status of the patient and the condition for which implantation is required. It would seem to me that implantation of the good ureter first is indicated, irrespective of the possibilities of repair, when the walls of the dilated ureter are thin, the patient is old and the presence of cancer is the reason for the operation.

The ureter chosen for implantation first is divided between ligatures as near the bladder as possible, or, when dealing with malignancy, as near as is safe. The bowel and ureter are then manipulated into position and the most favorable site for implantation is

carefully selected and marked by a stay suture at each end of the proposed line of incision. This portion of the bowel is flattened on the fingers by the thumb of the left hand. A piece of moistened gauze between the gloved hand and bowel greatly aids this proce-

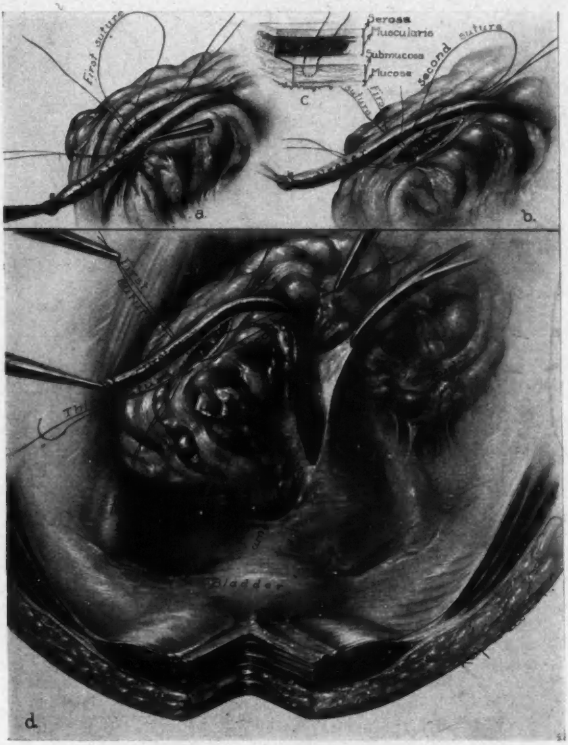

Fig. 1. The manner in which the three anchoring sutures are placed. *a*, Suture, number 1, is passed from left to right through the submucosa, right to left through the adventitia, care being used not to enter the lumen of the bowel or ureter. *b*, Suture, number 2, is passed opposite number 1. *c*, Method of placing each suture in the submucosa. *d*, The triangle of submucosa is marked off by the three sutures.

dure, and the bowel should be handled gently. A clean, straight incision of the serosa and muscularis is made down to the submucosa and the cut edges are separated by gently spreading them

with a mosquito clamp or by blunt dissection with the handle of the knife. None of the blood vessels of the submucosa should be injured, and the muscular layers as little as possible, by the separation.

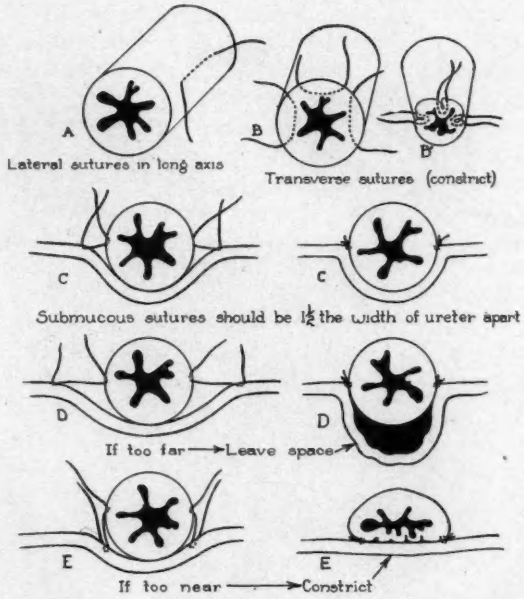

Fig. 2. The reasons for care in placing the anchoring sutures. *A*, the right method. *B*, The wrong method, a transverse suture. B^1, When tied, the transverse suture might constrict the ureter. *C*, The first and second sutures should be placed in the submucosa a distance apart of one and one-half times the diameter of the ureter so that when tied the ureter fits snugly, as shown in C^1, and not loosely when the sutures are too far apart. as shown in *D* and D^1, nor too tightly when too close, as shown in *E* and E^1.

THE THREE ANCHORING SUTURES

Anchoring sutures (of quadruple-0, 20-day chromic gut on atraumatic needles) are laid as is shown in Figure 1. These sutures stitch the submucosa of the intestine to the adventitia of the ureter and should pierce only these layers. Penetration of the lumen of the bowel or ureter may lead to a fecal or a urinary

fistula. If properly inserted the sutures are aseptic. The first two submucosal sutures in the bowel are spaced one and one-half times the diameter of the ureter (in diastole) and in line with the long axis of the ureter, for reasons which are illustrated in

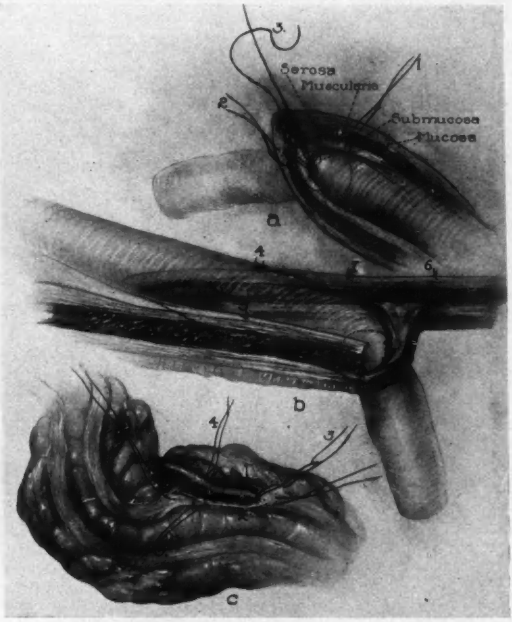

Fig. 3. Diagrammatic representation of the manner in which the ureter is anchored in the wall of the intestine by the five sutures. *a* shows how the sutures, numbers 1, 2 and 3, anchor the ureter snugly in the small opening through the submucosa and mucosa made by the cautery and illustrates the reason this slit should not be too large but of a size, as indicated by the dotted circle, equal to the diameter of the ureter; *b* represents the unconstricted anastomosis which is secured, and *c* shows how the fourth and fifth sutures anchor the ureter in the trough of the incision.

Figure 2. The loop of each is held, out about two inches, in mosquito clamps fitted with rubber guards. Traction on these loops later mobilizes the place for puncture of the intestinal wall and for insertion afterward of the end of the ureter through this orifice.

Usually these two submucosal sutures are placed in the lower end of the intestinal incision, in an area free from blood vessels, to avoid the complication of bleeding from their puncture by the needle. All three anchoring sutures can be placed in the submucosa to advantage immediately after the muscular layers have been

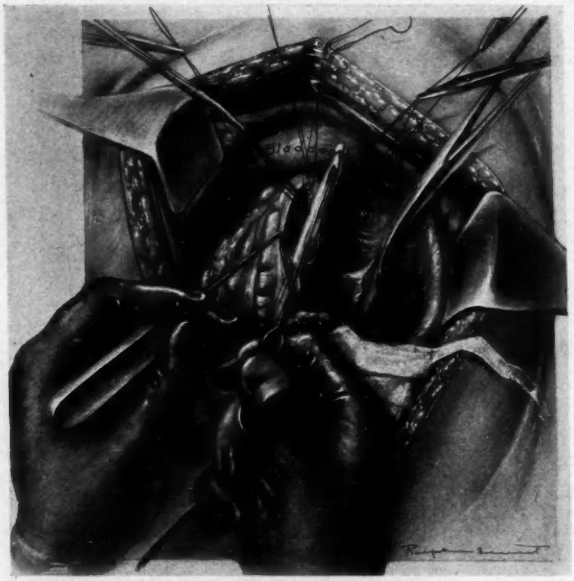

Fig. 4. The method of inserting the ureter with the probe through the opening into the bowel made by the cautery. After the ureter is inserted, the mosquito clamps with rubber guards, which are not shown in the illustrations, on the loops of sutures No. 1, No. 2 and No. 3, are withdrawn and these sutures are drawn tight and tied, thus anchoring the ureter in position, as shown in Figure 3.

separated, while the bowel is still held on the fingers with the thumb of the left hand.

The bowel is now released by the left hand and allowed to resume its usual position so that the ureter, which during this time has become distended with urine, can be laid over the line of incision and the proper level for the suturing of the adventitia can be more easily and accurately determined. The ureter should

enter, by the most direct and natural route, to that distance in the bowel at which it neither pulls because it is in too far, nor angulates because it is not in far enough.

The proper distance to which it is to be inserted having been chosen, the ureter is flattened on the fingers of the left hand by the thumb, and the needle, which was left on the first submucosal suture, pierces the adventitia of the ureter at the proper level, in

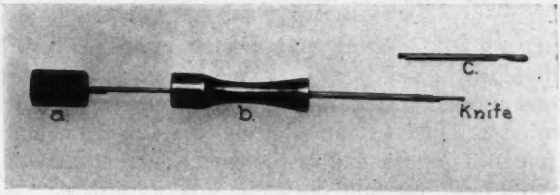

Fig. 5. Ureteral carrier (divided). Note: In order to free the end piece, *c*, the cutting stylet, *a*, must be fully withdrawn into the handle, *b*. It has been pushed out subsequently in this picture in order to show the knife.

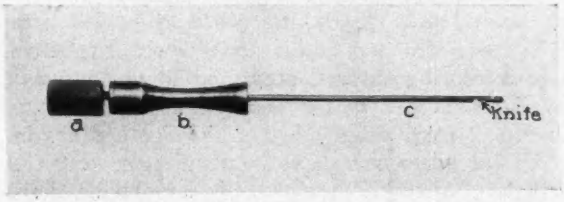

Fig. 6. Ureteral carrier (assembled). *A*, Cutting stylet. *B*, Handle. *C*, End-piece with cup in which is tied the catgut suture which is to be cut. The stylet is partially withdrawn showing the knife.

the reverse direction but equal in length to that already taken in the submucosa. The needle of the second submucosal suture is placed similarly in the opposite side of the ureter. It is important to place these sutures in the ureter so that when tied they will not cause the ureter to be twisted to one side or the other. Gentle traction, by an assistant, on the loop of the first stitch in the adventitia helps in the more accurate insertion of the second needle at the same level and exactly opposite. The ends of each suture are held together in a clamp and the needles are cut away. The third suture is laid. This is intended to sew the ridge of the

submucosa, below the opening to be made in it, to the upper wall of the ureter which will come into apposition with the submucosa just above its entrance into the lumen of the bowel (Fig. 3). When these three sutures are tied, they will seal the orifice aseptically and without constriction. Up to this stage of the operation, contamination from contents of the bowel or ureter has been impossible.

INSERTION OF THE URETER

The manner of inserting the ureter into the bowel—to be described below—avoids the contamination of the immediate area which sometimes occurred in the older method when the probe was withdrawn (Fig. 4). In addition, the newer method has the advantage of leaving the end of the ureter open so that urine does not have to drain through a slit in the side of the ureter until such time as this floating portion sloughs away. These were the two objectionable features in the previous technic.

The instrument for inserting the ureter in this manner has three parts (Fig. 5), namely the cutting stylet (a), the handle (b) and the end-piece (c) which, when assembled, form a stiff carrier (Fig. 6). The end of the ureter from 2 to 4 cm. beyond the line of anchoring sutures, according to the excess length of ureter available, is tied to the back of the carrier opposite the cup with No. 2 plain catgut so that the ligature lies in the cup and will be cut when the stylet is withdrawn (Fig. 7A). The excess length of ureter is removed by an oblique division with the cautery as close to the suture as possible, or, if cut, the end is treated with carbolic acid and alcohol. The end of the ureter thus fastened to the end-piece of the carrier is now ready for insertion.

The area of submucosa to be punctured is mobilized by traction on the submucosal loops, the incision is made and the carrier, with the ureter fastened to it, is inserted through this into the lumen of the bowel in the same manner as by the method with the probe and cautery, using the carrier in place of a probe (Fig. 4 and Fig. 7B). The three anchoring sutures are drawn close but not tied. Gentle traction on them holds the ureter in place until after the carrier has been removed, when they are tied. Holding the handle of the carrier firmly with one hand, the cutting stylet is withdrawn with the other and one feels, with the first pull, the

division of the ligature (Fig. 7C). The end of the carrier is felt now to be entirely free of the ureter. The cutting stylet is kept

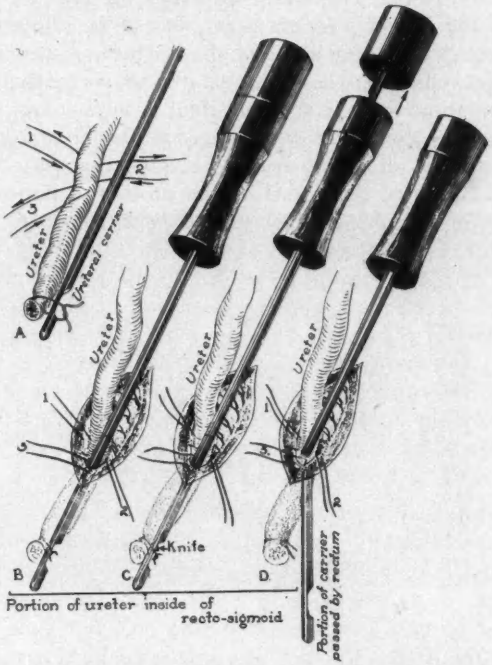

Fig. 7. The use of a divisible carrier for insertion of the end of the ureter into the lumen of the bowel. *A*, The end of the ureter is being ligated to the fenestration in the ureteral carrier. *B*, The end of the ureter, ligated to the fenestration in the ureteral carrier, has been introduced through an opening previously made with the cautery. The sutures, 1, 2 and 3, penetrating the submucosa of the recto-sigmoid as well as the adventitia of the ureter are tightened so as to hold the ureter in place. *C*, The knife of the ureteral carrier dividing the ligature which frees the end of the ureter and the end of the carrier within the lumen of the bowel. *D*, The end-piece of the ureteral carrier freed within the rectum, when the stylet is withdrawn into the handle. The remaining portion of the instrument has not been contaminated. The anchoring sutures 1, 2 and 3 are drawn taut and tied, sealing the opening in the mucosa and submucosa.

at this point for a moment and the instrument is pushed on in until the visible portion of the end-piece is seen to be just outside

the level of the submucosa; then the cutting stylet is withdrawn into the holder, which at once releases the holding joint between it and the end-piece. The end-piece drops off into the bowel, the stylet with the holder (which never should be allowed to reach the submucosa) is laid aside, and the anchoring sutures are tied. When the procedure has been carried out properly, there can have been no contamination of the intestinal wound. Any contamination that occurs comes from leakage at the time of tying the anchoring sutures, or afterward. This emphasizes the importance of the preparation of the bowel by the prolonged non-residue diet and the series of enemata beforehand with thorough syphoning off of the last one, and of careful attention to placing the anchoring sutures at the operation. They must stitch the intestinal submucosal and ureteral adventitial layers only, in order to avoid the formation of a fistula. They must be spaced properly in the submucosa and symmetrically opposite on the ureter so that, when they are tied, a snug implantation without looseness or constriction is secured, in order to prevent leakage and avert urinary obstruction afterward. Also the puncture wound of the submucosa must be of sufficient size, but not too large.

In order to prevent any possible herniation (which occasionally occurred experimentally at the place where the ureter penetrates the submucosa) the muscular coats should be joined over the ureter to the point of its entrance into the muscular channel. These sutures must be tied loosely so that they will not slough through and so that the ureter will not be constricted by them. If the incision of the bowel has been made in alignment with the ureter, both sutures 4 and 5 may be omitted, since the ureter will lie naturally in the channel. If the incision has not been made in alignment, however, there may be some tendency for the ureter to escape to one side or the other off the line and a suture will be required on the side opposite to this in order to hold the ureter in the submucosal channel (Fig. 3c).

The remaining steps (peritonization and closure without drainage) are completed as has been described before.

The end-piece of the carrier, dislodged into the intestinal lumen, comes away with the first or second movement of the bowels or can be removed by the use of a proctoscope.

SUMMARY

A simple aseptic method of submucosal implantation of ureters into the rectosigmoid is described.

The procedure can be done aseptically without risk of contamination or peritonitis provided the bowel has been prepared properly beforehand and the anchoring sutures are placed successfully at the time.

By this method leakage after operation (the ordinary cause of postoperative peritonitis) and undue constriction or twisting of the

Fig. 8. Specimen after removal in one piece of the bladder, prostate and seminal vesicles. *a*, Posterior view (unopened). *b*, Anterior view (open).

ureter (the ordinary causes of postoperative pyelonephritis and hydronephrosis) are minimized.

There still remains the uncertain and unknown factor of ascending infection by way of the peri-ureteral lymphatics or the ureteral lumen whenever the ureter opens into an infected area.

CASE REPORT

Bilateral Ureteral Implantation by the Aseptic Method with Divisible Carrier and Subsequent Prostato-seminal Vesiculo-cystectomy for Cancer of the Bladder

The patient, fifty-four years old, white, male, entered the hospital on September 26, 1935, complaining of painless hematuria of four months' duration. There had been a ten pound weight loss during

this period. During this time he had received extensive fulgurations of his bladder without any amelioration of his symptoms. His past and family histories were negative. On admission to the hospital physical examination was entirely negative except for marked pallor. Examination of the blood showed a secondary anemia of 47 per cent hemoglobin with 3,170,000 red blood cells. Cystoscopy revealed an extensive carcinoma of the bladder which on biopsy proved to be a papillary carcinoma. Intravenous urograms showed a normal bilateral upper urinary tract except for a double left renal pelvis. Phenolsulphonephthalein renal excretion and blood determinations were nor-

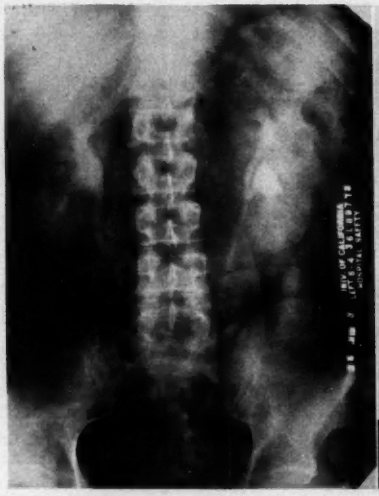

Fig. 9 *(left)*. Excretory urogram seven months after operation.

Fig. 10 *(right)*. Patient seven months after operation.

mal. Following multiple blood transfusions, the patient was considered a satisfactory risk for operation and on October 31 the left ureter was implanted into the rectosigmoid by the simple seven suture technic, the anesthetic being spinal, gas and oxygen. Following a slight rise of temperature to 38 degrees C. for five days postoperative the patient made an uneventful recovery and following further blood transfusions he was again submitted to operation on December 20. At this time the right ureter was implanted into the rectosigmoid by the simple seven suture method and a complete cystoseminalvesiculoprostatectomy performed* (Fig. 8a, b). Again the anesthetic was spinal, gas and

*Surg., Gyn. and Obs., 61:802-815, 1935.

oxygen. The patient recovered rapidly from operation, running a slight rise of temperature again to 38 degrees C. for about eight days and was discharged from the hospital on December 23, thirteen days following the second operation. During the postoperative rise of temperature on each occasion, bilateral tenderness was noted over each kidney which was most marked on the left. Following each operation there was a rise in blood urea nitrogen to 60 mg. per 100 c.c. which had returned to normal, 28 mg., before his discharge. Excretory urograms seven months following operation (Fig. 9) show a very mild dilatation of the upper urinary tract on either side. The patient has gained weight and enjoys perfect health (Fig. 10). He empties the rectum of urine four times during the day and perhaps once at night and is able to pursue his usual work without any discomfort.

DISCUSSION

DR. WILLIAM E. LOWER (Cleveland, Ohio): I would like to discuss Dr. Sisk's paper by reporting a case similar to the second one he reported. The patient was a school teacher, twenty-nine years of age, who had had recurrent severe attacks of nausea, vomiting, and pain in the right lower quadrant of the abdomen. These symptoms had been present for eight years; the appendix had been removed in the belief that appendicitis was the cause of the distress. A cholecystectomy and a pelvic operation had also been performed. The patient was seen by Dr. Engel who, in making a cystoscopic examination, found a double ureter on one side and retrograde catheterization showed one to end blindly. At operation, the ureter was removed and a year and a half later, the patient is entirely free from symptoms. She has gained in weight and has been able to return to her work without any interruptions due to the frequent attacks of nausea, vomiting and pain which she formerly experienced.

An interesting aspect of this case was that numerous nerve strands were demonstrated which extended from the tip of the blind ureter to the renal plexus. Catheterization reproduced the symptoms of which the patient complained. Perhaps of even greater interest was the fact that the ureter, on sectioning, was found to be perfectly normal without any sign of inflammation.

As Dr. Sisk has emphasized, these cases are probably overlooked more frequently than we suspect.

I think we are deeply indebted to Dr. Hinman for the very comprehensive report he made on the results of ureteral transplantation. As you know, all sorts of methods have been tried and, in cases where the operation succeeds, the patient may live on almost indefinitely.. We now have patients living from eighteen to twenty years following ureteral transplantation and these patients, or some of them at least, are apparently in quite good condition and are able to carry on with their work. Of course, others have died—some following operation, others years later. The fact that so many methods have been tried shows that none is yet entirely satisfactory.

PRESIDENT BARNEY: Dr. Wishard, by invitation, wishes to discuss Dr. Sisk's paper.

DR. W. N. WISHARD, JR. (Indianapolis, Ind.): I would like to show a slide of a patient that we had at City Hospital in Indianapolis, thirty years of age, who came to us complaining of symptoms typical of tuberculous cystitis. Cystoscopy revealed a bladder

Fig. 1. Antero-posterior and lateral pyelo-ureterograms showing accessory ureter ending blindly.

which was characteristic of that, but routine pyelography showed one of these blind ureters.

The lateral picture (Fig. 1) demonstrates the pouch, a little bit anterior to the course of the true ureter. This kidney, we felt, was by no means a normal kidney, although the urine contained no pus. Guinea pigs and tuberculosis stains were negative from both

sides. The right side showed mild hydronephrosis. We operated on this patient about two weeks ago through a left iliac incision, extraperitoneal, and resected this pouch down to a point about a half inch above the communication with the true ureter, leaving that much of a stump, for fear of constriction of the ureter, at the point of resection. Examination of the pouch or accessory ureter showed absolutely no evidence of any renal tissue at its

Fig. 2. Gross specimen of accessory ureter, removed at operation.

upper point. It had a fibrous band where the tip appears, which disappeared upwards, contained a vein but no evidence of renal stricture.

I doubt if this accessory ureter had any great relation to the complaints of the patient in the light of the fact that he is not improved since the operation. He had, by the way, gross hematuria over a period of ten or fifteen years, although I think that was connected with his bladder symptoms.

DR. DAVID W. MACKENZIE (Montreal, Canada): I wish to say something in regard to Dr. Sisk's paper. A few years ago Hawthorne and myself reported a series of aplastic kidneys. There were four of these cases which came to operation and we found in each case several cyst-like bodies in the loin, supplied by a small vessel. Leading downwards in two was a fibrous cord which

broadened out into a lower normal ureter. In two other cases the ureter ended blindly about the level of the fifth lumbar vertebra.

Judging from these cases we believe it possible that many of the cases of blind ureters reported are of a similar nature, having an associated rudimentary aplastic kidney.

DR. CHARLES C. HIGGINS (Cleveland, Ohio): I am certain that we have all enjoyed Dr. Hinman's paper very much indeed. In the literature at the present time, however, series of cases are reported by Dr. Mayo, Dr. Walters, Dr. Lower, and others, that indicate that transplantation of the ureters *per se* is a sound surgical procedure. I think the operative technic to be utilized in the individual case depends entirely upon the judgment of the surgeon and the findings observed by urologic investigation. In patients with extensive carcinoma of the bladder, dilated ureters, and poor renal function, transplantation of the ureters, if it is performed bilaterally, naturally will be accompanied by a higher mortality rate than when only one ureter is transplanted at operation. On the other hand, there are cases of exstrophy of the bladder in which the upper urinary tract is normal and I believe that in these cases simultaneous transplantation can be performed with a considerable degree of safety.

Most of the work that has been reported in the literature deals with refinements in operative technic with the intention of lowering the operative mortality and immediate morbidity. However, the problem that arises is what may be anticipated one, five, and ten years after operation. Why do some patients have dilated ureters and infected kidneys and others not? The answer to this requires a careful study of the anatomy of the cloaca in birds and the mechanism by which the ureters enter the cloaca. Do our operative principles such as utilized in the submucous technic simulate that closely? If careful study is made, it will reveal that there are some differences in the manner in which the ureters enter the cloaca in birds and that in which the ureters are implanted by the submucous technic.

Coffey's greatest contribution, of course, is the prevention of peritonitis. This has been accomplished by the submucous principle. The reason that the sutures occasionally slough out is due to the fact that part of the ureter incorporated in the bowel wall is the site of a peri-ureteritis and inflammation, and a peri-ureteral

exudate is usually present if Coffey I or II technic is used. If a dog is sacrificed two or three days after operation, you will not infrequently find peri-ureteral exudate in the trough of the bowel. When the technic we presented or the Coffey III principle is used, such a reaction about the ureter does not occur. With the submucous technic, the valvular mechanism is established which functions adequately in the majority of cases and intrarectal pressure cannot be transmitted up the ureter. In experimental animals in which the site of anastomosis has been examined, the bowel has been filled with sodium iodide but reflux up the ureter did not occur. Likewise, by measuring the intra-ureteral pressure following transplantation of the ureters, there is no evidence that intrarectal pressure can be transmitted to the upper urinary tract. In autopsy studies made on a patient in whom the operation was performed two or three years previously or if you study the kidney, ureters, and bowel at the site of anastomosis in dogs that have been allowed to live for a year or two with transplanted ureters, you will find no dilatation of the ureter that is incorporated in the bowel wall. This infers that the obstruction is not at the point at which the ureter opens into the bowel, but invariably it occurs at the point at which the ureter emerges from the trough of the bowel. That is the point at which the submucous technic differs from the manner in which the ureter first passes into the cloaca in birds. Therefore, I think that further studies are essential to establish the mechanism by which dilatation of the ureter and superimposed renal infection occur following operation.

Dr. Alexander Randall (Philadelphia, Pa.): It is always interesting in medicine to see how often those first working in a field find certain difficulties and focus their attention upon the correction of them, and how often those same authorities are apt to get off on the wrong foot. I think everyone has a feeling that in ureteral transplantation the one great bugbear is the question of infection. It has been driven home to us by every author. It is perfectly true that the patient dies of infection, but I have got a feeling from observations of one kind or another, and it is borne out by our knowledge of urology throughout, that the greatest factor of safety in ureteral transplantation is not the insistence on complicated technical methods to control infection as on the careful establishment of an unobstructed urinary drainage. Those

cases that are the successful cases seem always to be those which do not have ureteral obstruction. Therefore, they do not have ascending infection. I think what has been brought out today is of the utmost importance, and that is that our surgery should aim towards establishing a very competent functioning ureter without obstruction and the ordinary surgical technic will take care of the question of infection. Where there is obstruction, there is an invitation to infection, and the greatest preventive of infection, local or ascending, in the urinary tract is an unembarrassed drainage.

DR. LEON HERMAN (Philadelphia, Pa.): We have performed uretero-intestinal transplantation by the Higgins method in three cases. In one patient with cancer of the bladder a successful result was obtained, but this individual succumbed to a recurrence of the carcinoma some months after cystectomy. Two children with exstrophy of the bladder died following operation. One of these patients was operated upon by one of our general surgeons assisted by me, and I thought the technic was entirely satisfactory. However, the patient, unfortunately, developed acute bilateral suppurative pyelonephritis. The second patient was operated upon by myself shortly after the appearance of Dr. Higgins' first paper in which it was stated that counter-pressure was unnecessary. In this case the ligatures failed to cut through. The abdomen was reopened, the ureters were severed at their points of emergence from the bowel, and anastomosis completed by means of a fine electrode with which an opening was made into the lumen of the bowel. This patient succumbed many weeks later as a result in part of retroperitoneal suppuration. Our best results have been obtained with Coffey's first technic or second technic, and I feel that for children with exstrophy the Coffey-Mayo technic remains the superior method. In older patients the Coffey tube method performed in two stages would seem to be the method of choice.

DR. WILLIAM C. QUINBY (Boston, Mass.): I hope that Dr. Hinman will emphasize in his conclusions the fact that all successful surgery in any department is simple surgery and that this subject of uretero-intestinal anastomosis, as you can easily determine from his admirable exposition of it, has been clouded very definitely by too many complicating devices, with the result that the under-

lying factors which make for success have been overlooked or not perfectly understood.

It has been brought out by him, and I wish to emphasize the point and my agreement with it, that the problem is really not one of immediate postoperative peritonitis. That is not the problem at all, really. Anyone who has acquired a decent intra-abdominal technic can make a transplantation by any one of these various methods whether they are closed or open without any danger of peritonitis. The fundamental object to be striven for is so to implant the ureter that there is no obstruction and with increasing experience to choose the cases and choose the method which shall be used according to the problem which the individual patient brings. If the ureter is badly dilated, if the kidney above is already infected, the problem is quite different from that which obtains in, let us say, the simple case of exstrophy of the bladder.

Again, in your tabulation of results, do please differentiate the mortality in the cases of exstrophy where there is no complicating problem such as malignancy, from the end-results in the more serious and elderly cases of vesical carcinoma. It is well known today that those who deal with the surgery of children are getting excellent results following uretero-intestinal anastomosis in cases of exstrophy. The problem is quite different in malignancy and we must make a distinction in this regard in coming to any conclusion as to what the chances are for the patient. But I think we should all take away from this meeting the very definite fact that the old fear of peritonitis is gone. A decent technic does not fear peritonitis.

Dr. Frank Hinman (San Francisco, Calif.): I would like to show a few slides of a simple technic I have used on seventeen patients without a single instance of peritonitis. These cases, or twelve of them, were reported and analyzed. I simply wish to emphasize a simple modification of this technic which renders it fairly aseptic. In the first place, one should know before implanting ureters which ureter one is going to implant first. In cases of hydro-ureters, of course, the problem may be a nephrectomy.

(Slide) If one is going to do a two-stage operation it is probably well to make the first abdominal incision a right or a left rectus, according to which ureter is to be implanted. At the next operation, one can then do a midabdominal incision for the cys-

tectomy and the implantation of the second ureter. The most important part of the technic with this method is the preparation of the patient. He should have a low-residue diet for four days. He should have castor oil two days before, an enema that night, an enema the next morning and the next night and an enema again the morning of the operation. This final enema should be thoroughly taken from the lower bowel so the bowel will be perfectly empty and there will be absolutely no regurgitation when the bowel is opened.

The peritoneal flap should be made close to the bowel, as close as possible, because later the flap can be used to cover the site of implantation.

(Slide) In holding the bowel up between the fingers and thumb, one can then make a clean incision directly through the muscularis down to the submucosa and over the vessels. None of the vessels of the submucosa should be injured in any way whatsoever.

(Slide) After this incision is made, the sutures are placed, these mattress sutures are placed definitely in the submucosa, as shown here, so that the suture is in the submucosa. None of these sutures should in any way penetrate the bowel. Remember, sutures are placed perfectly aseptically.

(Slide) These sutures, of course, should go through the adventitia of the ureter only and they should be placed longitudinally and not laterally, because if they are placed in certain ways, they will constrict the ureter. They should be placed opposite in the submucosa, one and one-half times the diameter of the ureter apart, so that when they are tied there is a good fit in the submucosa and not a big loose space, and the fit is not too tight so it will constrict the ureter after being tied.

(Slide) The sutures are placed in the ureter and bowel so that they can be drawn taut, and then tied afterward. An incision is made in the bowel with a cautery, as shown in the next diagram.

(Slide) One can use this simple apparatus for implanting the ureter. The ureter is tied here, this has a stilette with a knife on it so that after the ureter is pushed into the bowel, this stilette can be pulled out and cut the suture, leaving the ureteral end free. As the stilette is pulled back into this handle part, the end piece drops off in the bowel so there is nothing drawn back out of the bowel after the ureter is pushed in.

(Slide) As shown here, the ureter is tied on the end, the ureter is passed in; after the anchoring sutures have been placed, the suture is cut off, the end piece pushed off and this has not entered to be contaminated, so it is more or less a perfectly aseptic implantation.

(Slide) The ureter has been properly implanted; there is no constriction. These are simple sutures, only seven sutures to implant the ureter into the bowel, leaving the end open for free drainage.

(Slide) The peritoneal flaps are brought over so they cover completely the line of implantation.

(Slide) Here is a man six months after bilateral implantation, after a prostatoseminal-vesiculocystectomy for an extensive carcinoma of the bladder.

OSSEOUS METASTASES OF CARCINOMA OF THE PROSTATE WITH SPECIAL REFERENCE TO THE PERINEURAL LYMPHATICS*

ROGER C. GRAVES, M.D., and (by invitation) SHIELDS WARREN, M.D., and PAUL N. HARRIS, M.D.

From the Pondville State Hospital for Cancer and the Laboratory of Pathology, New England Deaconess Hospital, and the Department of Pathology, Harvard Medical School, Boston, Massachusetts

A few years ago, we embarked on a study of the metastatic phase of carcinoma of the prostate, because while much attention has been directed to the diagnosis and treatment of this disease, less attention has been given to its end stages and to the spread of its metastases. We believed that the very chronicity of the process, extending through months or even years, creates problems of clinical interest and importance, and that there are questions not yet satisfactorily answered concerning the terminal changes presented by these unfortunate patients and the best methods for their relief. In particular, we raised very definite questions with reference to the mode of dissemination of malignant disease of the prostate. What is the pathway of spread? Why does this tumor possess its marked and well known predilection for bone? Why are the bones of the lumbar spine and pelvis chiefly involved? What is the behavior of the metastasis in osseous structures? This work was supported in part by a grant from the Wellington Fund through the interest of Dr. Wolbach, Professor of Pathology at the Harvard Medical School, and chairman of the Fund Committee. The first communication already published had to do with the purely clinical phases of this problem. This second report, which I have the honor to present today, is concerned with pathologic questions only, and is in the main the work of our pathologist, Dr. Shields Warren, and his associate, Dr. Paul N. Harris. (R.C.G.)

The high frequency of skeletal metastases of carcinoma of the prostate has been long recognized, ranging from over 70 per cent (Kaufmann[6]) to 30 per cent (Bumpus[1]). The frequency of involvement of the pelvis and the lumbar vertebræ has been noted

*Aided by a grant from the Wellington Fund of the Harvard Medical School.

by practically all observers, particularly Kaufmann,[6] Pürckhauer,[10] and Copeland.[2] The origin of these metastases has been frequently accepted as being due to blood-borne emboli, in accordance with the hemic hypothesis of von Recklinghausen.[12] However, it is difficult on this basis alone to explain the predilection for the pelvis and the vertebræ so frequently noted in prostatic cancer.

In cases of carcinoma of the breast, Handley[5] has insisted on the importance of extension of tumor into the bone from cancerous permeation of the adjacent deep fascial lymphatic plexuses. Willis,[13] with much justice, criticizes certain of Handley's hypotheses regarding the origin of osseous secondary deposits in cases of breast cancer. With many of Willis' statements we are in accord. He stresses, if Handley's conception is to hold, that bones suffer infestation as a sequel to continuous permeation of the fascial lymphatics, it would also imply regular infestation of the regional nodes. Kolodny[7] feels that in breast cancer and possibly in prostatic cancer the order of frequency of involvement of various bones may denote centrifugal spread from the primary growth.

Roberts[11] in his study of the spinal metastases of prostatic cancer has found that very frequently there are extensive growths and masses in the deep surfaces of the spinal laminæ and of their ligaments and he feels that the lymphatics of these ligaments may be important means of extension of the tumors from one part of the axial skeleton to another. He regarded the sacral lymphatics as the channel by which the tumor reached the vertebral column. In his cases the tumors were advanced and the objection has been raised that possibly the neoplastic infiltration of the ligaments might have been really secondary to deposits in the adjacent bone.

We believe, in view of the strikingly high frequency of osseous metastases in those bones adjacent to the prostate when carcinoma of that gland exists, that some other mechanism than fortuitous hematogenous metastasis must come into play. It is quite obvious that many of the metastases to bone are hematogenous. Definite proof of this has been submitted so many times that further evidence is unnecessary. However, there must be some further factor to account for the peculiar frequency of involvement of the adjacent bones, particularly when the metastases occur in bones such as those of the pelvis which are not involved with peculiar fre-

quency in osseous metastases from breast or pulmonary malignancy. In eighty-one cases of carcinoma of the prostate studied by Graves and Militzer,[4] 85 per cent showed x-ray evidence of metastasis to the pelvis and sacrum, 59 per cent to the lumbar spine, and only 35 per cent to the femora and 23 per cent to the dorsal spine.

So far as the central bone metastases are concerned there can be but little doubt that the blood stream is the sole means of their dissemination. However, many of the metastases of prostate cancer appear close to the cortex and in some of the cases which we will present later, actual infiltration through the cortical ostia may be seen.

In the course of our observations on autopsy and operative material, and clinical study of the patient, we were struck by the frequency of involvement of perineural lymphatics and also by the frequency with which pain, implying nerve involvement, appeared as a relatively early symptom. Thus with a small, non-obstructing cancer of the prostate pain on micturition may be marked, whereas with a large, hypertrophied prostate micturition may be extremely difficult but not painful.

Studies of the soft tissue in the neighborhood of the prostate convinced us that the perineural lymphatics might be an important pathway of dissemination of the tumor. So far as we have been able to determine, while there have been numerous studies of the lymphatic drainage of the prostate there has been no consideration of the perineural lymphatics as a mode of tumor dissemination. In fact, Roberts states casually, "The pelvic nerves appear free from invasion." Moore,[9] however, has called attention to the frequency of invasion of perineural lymphatics included within the tumor, even in early cases of the disease.

The present study represents an attempt to evaluate the importance of this mode of spread of carcinoma of the prostate. It also affords an explanation of the peculiar frequency of pelvic and lower vertebral involvement in this disease.

METHODS OF INVESTIGATION

Cases of carcinoma of the prostate, in some of which lower vertebral and pelvic metastases were known to exist, others in which they were not demonstrated during life, were chosen. The autopsy material was derived from the Pondville State Hospital for Cancer. In all cases skeletal x-rays had been made and in all,

the patients had been under observation for periods from few to many months.

The method of investigation was as follows: Instead of the routine autopsy procedure a block dissection of the prostate, bladder, rectum and soft tissues of the pelvis was carried out, together with such of the adjacent pelvic bones as could be readily obtained, as well as with sacrum and the bodies of the lower lumbar vertebræ. The body was then satisfactorily restored. These masses of tissue, obtained by Dr. T. B. Eberhard, resident pathologist, were then fixed in formalin until sufficiently hardened to be handled without fear of distorting the tissue relationships. Then horizontal sections were made through the tissue at intervals of approximately 5 mm. These were dehydrated, cleared, imbedded in celloidin, and sectioned on a large MacCallum microtome. The sections were stained in alum hematoxylineosin, and mounted in balsam. In such instances as the resulting sections could not be mounted on a 3¼″x4¼″ slide, they were divided into two or three portions in such manner that they could be readily reconstructed. In those sections containing bone, decalcification with 5 per cent nitric acid was carried out before preliminary sectioning. Decalcification was extraordinarily difficult in some of the cases with marked osteosclerotic metastases, not only a long period of decalcification being required but the final sections being not entirely satisfactory. Relatively large masses of the bone were decalcified in order to avoid the distortion of tissue relationship that might result from sawing.

The resulting sections were sufficiently good to permit study under moderate power of the microscope. The major details could be determined fairly well by using the mounted slide as a lantern slide and projecting it against a screen for study.

These sections have been supplemented by examinations of sections from a very considerable number of cases of carcinoma of the prostate removed surgically or at autopsy.

As will be seen from our cases, the cancer was usually advanced, although in one (Case 8) unrecognized clinically. One carcinoma of the bladder was included as control (Case 6).

REPORT OF CASES

Case 1 (33-A-133).—An American farmer, aged seventy-six, was admitted to the hospital February 9, 1933. Urinary incontinence began following a suprapubic operation five weeks before. The patient

Fig. 1. Photograph of one of the large sections used in our study. The prostate shows widespread tumor invasion. Lymphatics in the capsule are invaded, and in the left center is a large tumor mass in a perineural lymphatic. × 18.

reported pain in left thigh for one year; rectal incontinence for eight months; loss of weight for two or three years. Examination revealed a poor general condition and presence of Parkinson's disease. The rectum was almost occluded with a hard irregular mass filling the whole rectal cavity.

X-ray Reports.—"February 13, 1933, examination of pelvis: Shows rounded areas of increased density varying from 1 to 3 cms. in diameter scattered throughout the bones of the pelvis. There is dense bone over the upper part of the sacrum. The second lumbar vertebra is also involved in a metastatic process. The same process is also present in the left femur, from the greater trochanter down to mid shaft. The lower part of the femur is not demonstrated. The findings are quite characteristic of metastatic disease from carcinoma of the prostate. Examination of the kidneys: Following the intravenous ingestion of dye, the kidney pelvis and calyces are fairly well demonstrated on both sides. There is considerable tortuosity of the right ureter and slight dilatation.

"February 18, 1933. A portable examination of the chest shows an area of dullness in the upper right lung field which looks like a pneumonic process. I do not believe it is metastatic. There are a number of areas of density in the ribs which are apparently bone metastases."

Tissue removed from the rectum for biopsy showed carcinoma; material was insufficient for classification. Treatment at Pondville: Colostomy was performed March 6, 1933. The patient died September 19, 1933. The interval between the onset of symptoms and discovery of metastases was one year. Length of life after discovery of metastases was seven months.

Final Diagnosis (Autopsy).—Carcinoma simplex of prostate with extension to soft tissues of pelvis and rectum and metastases to pelvis and spine and para-aortic lymph nodes; bronchopneumonia; mitral and aortic valvulitis with insufficiency; pyelonephritis; retention cysts of kidneys.

The patient showed marked emaciation with a permanent colostomy opening in the anterior abdominal wall. The lower lobes of both lungs were dark red-purple in color and a large amount of bloody fluid was expressed, together with some yellow purulent material. The gastro-intestinal tract was normal except for the lower end of the rectum, which was closely adherent to the prostate and surrounding soft tissues, and completely surrounded by tumor. The lumen was almost completely occluded by encroachment of the tumor. The involvement extended along the axis of the rectum about 5 cm. Findings in both kidneys were essentially negative; the right kidney weighed 140 gms., the left 160 gms., each with several thin, smooth-walled cysts 1.5 cm. in diameter. The cortex was 3 mm. thick, dark red and poorly demarcated. Several soft, yellowish-red pyramidal foci

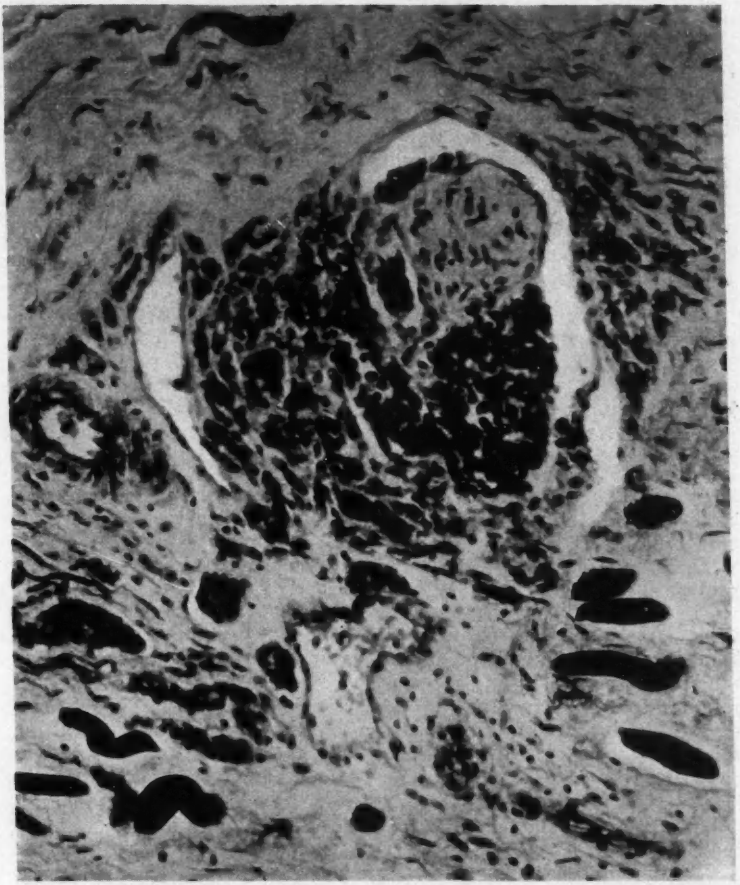

Fig. 2. Prostatic capsule showing much distention of perineural lymphatics by tumor cells. Small tumor masses are present in other lymphatics. The coarse black structures are skeletal muscle fibres. ×235.

with the bases toward the periphery were seen in each kidney. The pelvic mucosa was somewhat injected and thickened. The bladder was small and thick-walled. The mucosa was smooth but injected. The trigone was elevated by a nodular bulbous fold extending transversally across it for 2 cm. and extending 0.4 cm. above the floor. On section the floor of the bladder was continuous with the prostatic

mass. The prostate was removed together with the bladder, soft tissues of pelvis, coccyx, and portion of sacrum and lower lumbar vertebræ. The mass replacing the prostate was large, hard, yellowish-white and granular, shading off into the surrounding tissue. The pelvic, iliac and para-aortic lymph nodes were enlarged up to 1.5 cm. in diameter, hard, somewhat adherent to surrounding structures, on section yellowish-white and granular. There were some foci of necrosis. The aorta showed marked atheromatous change. The body of the second lumbar and part of the third lumbar vertebræ were made up of yellowish-white eburnated bone. The remainder of the lumbar vertebræ, the sacral vertebræ and coccyx showed no abnormalities in spite of the x-ray evidence of metastases in them.

Microscopic Findings.—The tumor was made up of strands and clusters of small, closely-packed polyhedral cells of epithelial type. Occasionally these formed ill-defined acini. Cytoplasm was finely granular, rarely vacuolated, rather darkly staining. Nuclei were fairly large and hyperchromatic. Microscopic section of the pelvic bones showed the marrow spaces heavily infiltrated with tumor. Other bone sections showed no evidence of tumor.

Description of Large Sections.—The prostate was diffusely invaded by the tumor, and perineural invasion in the capsule was striking and constant.

The posterior bladder wall showed much tumor invasion, but the ureters showed none.

The muscularis of the rectum contained small tumor masses, but there was much infiltration of the tissues between the rectum and bladder and prostate. The tumor tissue extended postero-lateral to the bladder and up beside the rectum. The seminal vesicles were surrounded by tumor and showed much tumor invasion. The muscularis of the terminal portions of the vasa showed some encroachment. In this region perineural invasion was seen very often, but was not as constant as in the prostatic capsule. A small amount of tumor was seen in the vicinity of the iliac vessels, some of which was perineural. Several tumor-invaded nodes were seen here and anterior to the lower vertebræ.

The sacrum and lumbar vertebræ contained no tumor, but there were foci up to 1 cm. in diameter in which the marrow was fatty and in which the trabeculæ were thin and less numerous than elsewhere. The periosteum contained no tumor.

Case 2 (33-A-115).—An American artist, aged seventy-two, was admitted to the hospital May 3, 1933. He reported urinary frequency and urgency for nine months, with complete retention for five weeks, and pain in the right thigh. X-ray therapy had been given. He had lost 29 pounds in one year. Examination revealed a poor general condition. The prostate was extremely large, uneven and very hard.

Fig. 3. Section through the edge of the prostate showing several masses of tumor cells in perineural lymphatics. The lymphatic walls are readily distinguished. × 560.

There was induration in the seminal vesicle regions, especially on the left side.

X-ray Reports.—"May 5, 1933. X-ray examination of the lumbar spine and pelvis: There is extensive hyperplastic metastatic malig-

nancy involving the sacrum, the right ilium and ischium and the left ischium. Metastases most probable from cancer of the prostate.

"June 2, 1933. Examination of the colon shows some enlargement of the colon throughout. The rectum is not as large as one would expect it to be, but the contour is quite regular. Cannot find any evidence of disease in the colon.

"July 20, 1933. X-ray examination of the dorsal spine shows involvement of one of the lower dorsal vertebræ by metastatic disease from the prostate. A film of the skull is negative. Examination of the chest shows no evidence of metastases."

Nausea and vomiting developed, with marked elevation of blood non-protein-nitrogen. The patient died September 21, 1933. The interval between onset of symptoms and discovery of metastases was nine months or less. Length of life after discovery of metastases was less than one year.

Final Diagnosis (Autopsy).—Carcinoma simplex of prostate with extension to bladder and ureter; metastases to left and right ilium, sacrum, second and third lumbar vertebræ and iliac, pelvic and para-aortic lymph nodes; pyelonephritis and pyoureter, right; hydronephrosis and hydro-ureter, left.

There was marked emaciation. Gross findings were essentially negative except for the genito-urinary system and bones. Kidneys weighed right 120 gms., left 125 gms. The right kidney on section proved to be only a thin shell of kidney substance, approximately 3 mm. in thickness, forming a multilocular sac filled with pus. Mucosa was hemorrhagic and covered with reddish-green slough. The left kidney showed some dilatation of the pelvis, which contained 20 c.c. of clear urine, its cortex 3 mm. in thickness, poorly demarcated. The right ureter dilated to 1.5 cm. with thick, inelastic wall and lumen filled with pus. The left ureter 2 cm. in diameter, was thin-walled, and contained clear urine. The bladder was empty, wall contracted, mucosa thick and trabeculated, covered with yellowish-green slough. A soft, reddish-gray, spongy mass of tumor tissue about 1.5 cm. in diameter extended 0.5 cm. above the bladder floor between the urethral orifice and the left ureteral orifice. The prostate was entirely replaced by yellowish-white, granular, hard tumor tissue which had replaced the entire gland and invaded the bladder wall and adjacent soft parts of the pelvis for about 1 cm. Seminal vesicles were lost in the mass of tumor. Pelvic, iliac and para-aortic lymph nodes were enlarged, hard, fixed to surrounding tissue. The second and third lumbar vertebræ, all the sacrum and many foci in the ilium were composed of pale yellow eburnated bone infiltrated by tumor.

Microscopic Findings.—Microscopic examination showed cords, masses and poorly-formed acini of large irregular cells of finely granular cytoplasm and large vesicular nuclei. Mitoses were rare. Stroma was scanty. There was marked lymphatic invasion. Centers

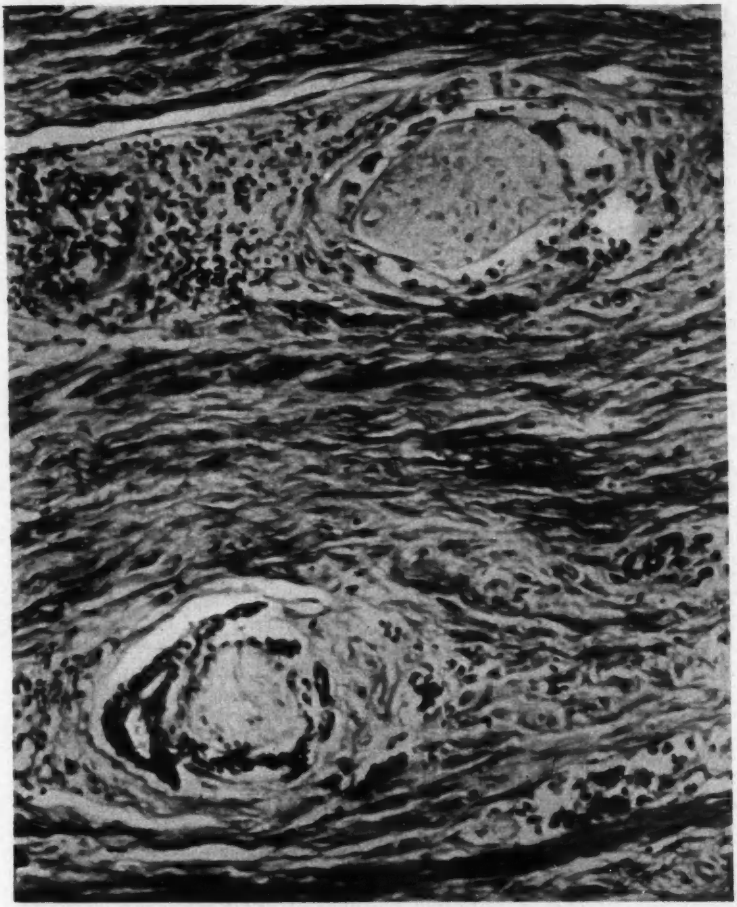

Fig. 4. Prostatic capsule. Tumor cell invasion of the lymphatics about two nerves is seen. In one, the tumor cells form glands. × 235.

of some of the larger masses were necrotic. The bladder wall showed heavy infiltration with tumor. Almost all lymphoid tissue in the nodes was replaced by tumor. Section of vertebra showed heavy infiltration by tumor.

Description of Large Sections.—There was moderate invasion of

lymphatics in the muscularis of the rectum, and many were perineural. Mucosa and submucosa showed subacute inflammation.

The prostate showed widespread invasion and in the capsule was extensive and fairly constant perineural invasion.

The bladder inferiorly, posteriorly and on one side contained moderate infiltration. Ureters contained no tumor.

There were small masses of tumor between the prostate and bladder and rectum, and a few small masses lateral to the rectum, much more on the left. One seminal vesicle was partly obliterated. The vesicles showed very slight peripheral invasion and they and the vasa were surrounded by tumor. A few lymphatics in adventitia of the arteries near the rectum contained tumor. Some perineural invasion was present at a distance from the prostate, and beside the iliac vessels were large tumor masses in perineural lymphatics. One lymph node near the sacrum and two nodes near the vertebræ showed much invasion. Other nodes were normal.

Tumor was present in the sacrum and vertebræ and had caused much proliferation of bone. The periosteum contained a small amount of tumor. In a few foci extension of the tumor into the bone appeared to be by way of penetrating lymphatics in the cortical foramina. Elsewhere it appeared to be by direct extension.

Case 3 (33-A-121).—An American mechanic, aged fifty-six, was admitted to the hospital June 20, 1933, with a history of nocturia, four to five times, for one year; pain in the back for six months. High voltage x-ray treatment over the anterior and posterior pelvis had been given before admission. The patient had lost 15 pounds or more in the past year. Examination showed a fair general condition. The prostate was very slightly enlarged and hard, with extension of induration into the right seminal vesicle region.

X-ray Report.—"June 26, 1933. Examination of the pelvis shows no very definite evidence of metastatic disease. In the left pubis there is slight irregularity in the appearance of the bone which might be due to a metastatic process. Very definite lesions are present in the dorsal spine. The ninth dorsal vertebra is beginning to narrow down. There is definite narrowing of the seventh and beginning wedging of the fifth. There is also pathological fracture of the left clavicle with beginning moth-eaten appearance around the margins of the fracture."

Deep x-ray therapy was given over the dorsal spine and left clavicle. On August 5, 1933, chordotomy was performed for relief of pain. Pain persisted in the left shoulder region. The patient died September 27, 1933. The interval between the onset of symptoms and discovery of metastases was about ten months. Length of life after discovery of metastases was five to six months.

Final Diagnosis (Autopsy).—Carcinoma simplex of the prostate, with metastases to lungs, diaphragm, pleura, thyroid, peritoneum, kid-

ney, liver, adrenals—left and right, spleen, eighth, ninth and eleventh dorsal and third and fifth lumbar vertebræ; left clavicle (pathologic fracture); sixth rib, right; pelvic, para-aortic, mesenteric and mediastinal lymph nodes; arteriolar nephrosclerosis; hydrothorax, bilateral.

The body was that of a well developed and nourished elderly white male with swelling and abnormal mobility of the outer third of the left clavicle. Significant post mortem findings were numerous nodules of yellow-white, granular, hard material over the peritoneal cavity and pleural cavities. Scattered hard nodules, small in size, were present throughout both lungs. The lungs were somewhat soggy. The gastro-intestinal tract showed no abnormalities except the last few centimeters of the rectum, which showed the muscularis and perirectal tissues hard and apparently infiltrated by tumor. The liver, which weighed 1,700 gms., showed evidence of central necrosis. The left adrenal showed nodules of gray tissue in the medulla. Kidneys weighed 170 gms. each. On section the cortex was poorly demarcated, glomeruli prominent, pelvic mucosa injected. The bladder was empty. The mucosa was thickened and injected, covered with yellowish-green slough. Pelvic, para-aortic, mesenteric and mediastinal lymph nodes were enlarged, hard, and adherent to the surrounding tissue. On section they appeared to be infiltrated with tumor. The thyroid showed two nodules of metastatic tumor. Bone: outer third of clavicle showed nodule of tumor tissue approximately 5x3 cm., which completely destroyed the bone. The right sixth rib was involved. Nodules of tumor tissue were in the eighth, ninth, eleventh dorsal, third and fifth lumbar vertebræ.

Microscopic Findings.—Essentially the microscopic findings confirmed the gross with the addition of metastatic tumor in the splenic pulp, invasion of the appendix by extension of tumor from mesentery, the presence of foci of tumor in the liver, metastasis to one kidney. The prostate was heavily infiltrated by tumor showing large foci of necrosis with abundant stroma and considerable fibrosis.

Description of Large Sections.—The prostate was diffusely invaded by tumor, and in the capsule perineural and even endoneural invasion was striking and fairly constant.

The bladder showed little invasion, but a cord of tumor extended up a lymphatic in the serosal fat to the fundus. Ureters and vasa showed no invasion. The lower parts of the vesciles were filled by tumor, but there was little in their walls.

Tumor was present in the anal submucosa and sphincter, and here there was striking and fairly constant perineural invasion. The rectum was closely applied to the lower part of the prostate and there was extensive tumor invasion of its muscularis. Some invasion here was perineural. One nodule invaded the sigmoid from the serosa.

There was very little tumor between the rectum and prostate but many small nodules were seen in the peritoneum of the pouch of

Douglas. A few small tumor masses were seen lateral to the rectum, some perineural.

The coccyx contained no tumor. The sacrum and lower vertebræ showed fairly extensive invasion with little bone destruction. The upper vertebræ had no tumor. The periosteum contained a moderate amount of tumor with direct invasion of bone in several places. Some tumor was present in the perineural and perivascular lymphatics in the periosteum. Tumor could not be traced in an unbroken chain from the prostate to bone, and embolic spread via perineural lymphatics seemed probable.

Case 4 (33-A-109).—An American farmer, aged eighty-eight, was admitted to the hospital April 29, 1933, for treatment of basal cell carcinoma of the left inner canthus of one year's duration. There was a history of increasing constipation in the past year. The patient reported nocturia and partial incontinence, beginning with a sudden attack of complete retention three years ago. There had been pain in lower back and left knee for one year. There had been no loss of weight. Examination showed a fair general condition. Blood nitrogen was elevated. There was a large mass in the region of the prostate, surrounding the rectum laterally on each side; marked extension into the region of the seminal vesicles. No rectal ulceration was found by proctoscopy.

X-ray Reports.—"May 1, 1933. X-ray examination of the pelvis and lumbar spine and knee shows very extensive hypertrophic changes, but no evidence of metastatic disease.

"June 19, 1933. X-ray examination of the chest. The lung fields are essentially clear. There is probably slight dullness at the left base. The diaphragm is not seen on that side. This might be due to consolidation or a slight amount of fluid at the left base."

Treatment.—Radium was used in the lesions of the left inner canthus and suprapubic cystostomy was performed. The patient died September 14, 1933, after a long downhill course marked by clinical signs of urinary tract and pulmonary infection. The interval between the onset of symptoms and discovery of metastases at autopsy was three years and five months.

Final Diagnosis (Autopsy).—Adenocarcinoma of prostate with metastases to pelvic and para-aortic lymph nodes; basal cell carcinoma of left inner canthus; bronchopneumonia; chronic nephritis; multiple colloid adenomatous goiter; adhesive pleuritis and hydrothorax; chronic mitral valvulitis and hypertrophy of heart.

The body was that of a well developed but markedly emaciated, elderly white male. In the mid-line was a suprapubic cystostomy opening. Post-mortem findings were essentially negative except for soggy firmness of both lower lobes with a large amount of yellow pus in the bronchioles. The gastro-intestinal tract showed no abnormalities except for marked thickening of the submucosa and injection of

mucosa in the region of the prostate. Kidneys each weighed 125 gms. Small, firm, capsules stripping with some difficulty from a raw, reddish-brown, granular surface. On section cortex 0.5 cm. in thickness, poorly demarcated. Pelves and ureters negative. Bladder empty, with trabeculation and injection of mucosa, and a thin layer of yellowish-green fibrin present. Floor of the bladder elevated but not eroded. The prostate was enlarged to about twice its normal size, hard and nodular, yellowish-white. Capsule was apparently invaded at the base of the gland. Lymph nodes: Few moderately enlarged grayish-pink nodes in the right pelvic chain and along the right para-aortic chain. Bone negative.

Microscopic Findings confirmed the gross. The tumor was made up of large, polyhedral, closely-packed cells with finely granular cytoplasm and large vesicular hyperchromatic nuclei. These were arranged in poorly formed acini, cords and clusters. Stroma was loose, abundant and cellular. There was very little mitotic activity. The lymph nodes showed partial replacement with tumor tissue.

Description of Large Sections.—(This case showed the most extensive and constant perineural invasion.)

The prostate was diffusely invaded by tumor, as was its capsule, and in the latter there was extensive and striking perineural invasion.

The posterior bladder wall below the ureteral orifices was fairly widely invaded, but infiltration above the ureters faded out fairly rapidly.

The proximal parts of the ureters and vasa were invaded for a short distance. Seminal vesicles showed much invasion, and in the tissue about them were many cords of tumor ranging up to 2.5 mm. in diameter.

The muscularis and submucosa of the rectum were extensively invaded. No tumor was present in sigmoid or upper rectum. A fairly large amount of tumor was present in lymphatics adjacent to the rectum, and much of this was perineural. In the sections with prostate and vesicles the greater part of the tumor was anterior, but above the prostate it was posterior to the rectum and in some sections tumor-replaced lymph nodes were seen here. This tumor-infiltrated tissue extended unbroken up the sacrum, and everywhere perineural invasion was very extensive.

The tumor also spread laterally, but much less conspicuously, until the lymph nodes beside the hypogastric and iliac vessels appeared. These were widely invaded. Sections higher up showed more tumor in the surrounding tissue and here, too, perineural invasion was very striking. This could be traced to the aorta. The periosteum in most of the sections contained tumor masses (some perineural) and in some places the tumor extended directly into the bone. In a few foci tumor extended into the bone from about the vessels in the outer part of the periosteum. Bone contained much tumor.

Comment.—This case and the preceding one offer a striking contrast between the small, hard, malignant prostate, metastasizing widely, in a relatively young man and the large prostatic mass in an old man, with but few secondary deposits of tumor. Such differences in behavior have been commented upon by Ferguson[3] and by Graves and Militzer.[4]

Case 5 (33-A-88).—An American mechanic, aged seventy-one, was admitted to the hospital, April 15, 1933. Sudden onset of obstructive bladder symptoms occurred six weeks before. Weight loss was 25 pounds. Examination revealed a feeble man, with evidence of marked loss of weight. Kidneys were palpable but not tender. The prostate was large and hard, with induration extending into the seminal vesicle region beyond the reach of the examining finger. Cystoscopy: Trigone was irregular and elevated; ureteral orifices normal; edema and ulceration at internal sphincter margin on the left side.

X-ray Reports.—"April 18, 1933. X-ray examination of the pelvis and chest: Shows no evidence of metastatic malignancy.

"May 2, 1933. Examination of the lumbar spine shows pronounced hypertrophic changes, but no definite evidence of metastases.

"July 21, 1933. A film taken post-mortem of the pelvis shows very extensive metastatic process involving chiefly the pubis, but also all the bones of the brim of the pelvis. There are also beginning changes in the upper end of the right femur. Do not believe that there is much involvement in the lumbar or dorsal spine."

The patient gradually failed and developed signs of marked uremia. He died July 21, 1933. The interval between the onset of symptoms and discovery of metastases at autopsy was about five months.

Final Diagnosis (Autopsy).—Carcinoma simplex of prostrate, with extension to bladder; metastases to lungs, liver and inguinal, pelvic, para-aortic and abdominal lymph nodes, including nodes at hilus of liver; bronchopneumonia; pyelonephritis and pyo-ureter, left; arteriosclerosis.

The body was that of a well developed, markedly emaciated, elderly white male. Findings were essentially negative except for the liver weighing 1740 gms., which was thickly studded with yellowish-white nodules from 1.0 to 2.5 cm. in diameter. Kidney weight was: right 120 gms., left 160 gms. The findings in the right kidney were essentially negative. The left kidney showed poor demarcation of the cortex and prominent glomeruli. The pelvis was dilated, and contained 10 c.c. of cloudy urine. The left ureter was dilated to 0.6 cm. in diameter, the wall thickened and indurated. The right ureter was not remarkable. The bladder contained 250 c.c. of cloudy, foul urine. Mucosa of the fundus was markedly injected. The floor was occupied by a fungating central tumor approximately 3 cm. in dia-

meter extending about 1 cm. above the mucosa. This was necrotic and ulcerated in the center; margins were irregular. It was continuous with the prostatic mass. The prostate itself was considerably enlarged, firm, with the left lateral lobe very hard. The architecture was obliterated. The gland was markedly adherent to the adjacent structures and encroached on the ampulla of the rectum. The inguinal, pelvic, para-aortic and all abdominal lymph nodes, including those at the porta of the liver, were enlarged, firm, and on section were yellowish-white and granular. Sections of the left ilium and the lumbar vertebræ showed lipping at their margins but otherwise were not grossly remarkable.

Microscopic Findings confirmed the gross except for the addition of early metastases in the lung. The tumor was composed of strands and masses of poorly formed acini made up of acidophilic tumor cells varying greatly in size and shape, with finely granular cytoplasm and moderate-sized reticular nuclei. Mitotic figures were comparatively rare.

Description of Large Sections.—Perineural invasion in this case seemed less significant than in the other cases.

There was widespread tumor invasion of the prostate and its capsule, and in the latter, perineural invasion was seen but the other lymphatics were more uniformly invaded and contained larger masses.

The bladder was invaded and in the posterior wall was a large polypoid mass (2x3 cm. in one section) which extended into the lumen.

The ureters and vasa were not invaded. Some tumor was present in the periphery of the proximal part of the seminal vesicles.

There was extensive invasion of the tissue between the prostate and rectum with formation of large tumor masses. One mass in the fat here measured 1x3 cm. The lymphatics here were much enlarged by tumor masses. Perineural invasion was present, but the masses in these lymphatics were smaller than the others and there were many uninvolved nerves here. Perineural invasion was not seen at a distance from the large tumor masses. The vasa and vesicles, in places, were surrounded by tumor, but not invaded.

The anterior rectal wall was extensively invaded and submucosa contained a mass 1x2.5 cm. in one section. Large masses were present in the muscularis, too, but the tumor disappeared at level of lower end of seminal vesicles. Several lymph nodes, anterior and posterior to the rectum, were replaced by tumor. Lymph nodes beside the iliac vessels were invaded. There were numerous large tumor-replaced lymph nodes anterior to the sacrum and vertebræ, some lying against the bone. The sacrum and vertebræ showed much invasion, but although there was much tumor on both sides of the periosteum, in many sections, the periosteum contained no tumor. In some sections a small amount of tumor was seen in the lymphatics in the periosteum, and in three sections the periosteum contained more tumor, and direct

extension into bone was seen. A few small veins in and outside the periosteum contained tumor and a rare example of perineural invasion was seen.

Case 6 (33-A-136).—(Bladder carcinoma included for control). An American mill-worker, aged fifty-nine, was admitted to the hospital, September 25, 1933. He reported difficult urination, dysuria and increased frequency for about eight months. Suprapubic cystostomy was done two weeks before admission. There was a history of gonorrhea and syphilis. Blood Wassermann and Hinton tests were negative at Pondville. Weight was 30 to 35 pounds below the usual average. Examination showed an appearance of anemia and weight loss. The right kidney was faintly felt and slightly tender. There was a catheter in the suprapubic sinus. The prostate was very slightly enlarged and benign. Cystoscopy: Urine was foul and there was extensive ulceration and slough.

X-ray Reports.—"September 28, 1933. Examination of the pelvis: Density of the bone of practically the entire right side of the pelvis. Considerable thickening of the bone and increase in the prominence of the trabeculation. There is also definite increase in the density of the upper part of the left femur. Not much change in the left iliac bones or in the spine. No change in the upper part of the right femur. The changes are almost characteristic of Paget's, but could conceivably be due to metastatic disease. Would like to have a few more films of other bones. The films of the chest show no evidence of metastases. No evidence of disease in the lung fields.

"October 3, 1933. Further examination includes a lateral view of the skull and the left femur. The skull film shows a number of fairly well defined areas of increased density in the bones of the vault. The femur presents some actual expansion on the bone in the upper half of the shaft, and rather coarse trabeculation. I believe this patient has Paget's disease. He may have metastatic malignancy of the bones of the pelvis in addition to Paget's disease."

Gradual failure was evident in the next few weeks and death occurred November 2, 1933.

Final Diagnosis (Autopsy).—Papillary epidermoid carcinoma, grade II, of bladder; extension to perivesical soft tissues; pyelonephritis; aortic insufficiency; multiple colloid adenomatous goiter.

Post-mortem findings were essentially negative except for marked emaciation; the old suprapubic cystostomy was in good condition. Kidneys weighed: right 160 gms., left 140 gms. Capsule stripped with difficulty from an irregularly rough surface, leaving foci of yellowish-green necrotic material. Numerous foci of very irregular outline up to 2 cm. in diameter were scattered through the renal substance. Ureters were thick-walled, each dilated to about 0.4 cm. Mucosa was covered with yellowish-green exudate. Bladder was adherent to the

anterior abdominal wall at the region of the cystostomy. The bladder was contracted. Anterior and left lateral walls were occupied by a large fungating ulcerated mass, roughly 9 cm. in diameter, extending from the internal sphincter almost to the apex. The tissue was soft and friable. On section the tumor was pale red to yellowish-white, granular, firm, and invaded the entire thickness of the bladder wall, including the perivesical soft tissues. There were a few slightly enlarged para-aortic lymph nodes which contained small, yellowish necrotic foci. Bone findings were negative except that the left femur showed some thickening of the cortex and fibrosis of the marrow cavity.

Microscopic Findings confirmed the gross. The tumor consisted of coarse masses of large, irregularly-shaped cells, supported on a loose, vascular, rather papillary stroma. The cytoplasm was darkly staining, finely granular, and often vacuolated. Nuclei were large, vesicular and hyperchromatic, with rare mitotic figures. There was marked necrosis.

Description of Large Sections.—The anterior bladder wall was extensively invaded by tumor tissue, but the posterior wall contained very little tumor. In sections five, six and seven, a few small tumor masses were seen about the seminal vesicles and in five, one vein anterior to the rectum was occluded by a mass of tumor cells. No tumor was seen elsewhere.

Case 7 (33-A-154).—A Canadian tailor, aged fifty-eight, was admitted to the hospital August 8, 1932. There was a history of increased frequency of urination and retardation of stream for six months. Pain was felt in the right flank and groin, but none in the back or legs. Loss of weight was 12 to 15 pounds. Examination showed a good general condition. There was tenderness in the right renal area and the kidney was faintly palpable. There was a large right hydrocele. The prostate was moderately enlarged, firm and irregular. Upward extension was more marked on the right side. Cystoscopy: There was hypertrophy of the trigone; irregularity and marked edema of internal sphincter margin, especially posteriorly.

X-ray Reports.—"August 15, 1932. Examination by intravenous pyelogram: The dye is secreted well on the left side. The left kidney pelvis appears normal. There is practically no function on the right.

"September 2, 1932. X-ray examination of the lumbar spine and pelvis shows no evidence of metastatic malignancy."

X-ray therapy consisted of 1500 r units each to the anterior and posterior pelvis. October 5, 1932: Perineal implantation of radium into the prostate (5544 m.c. hrs.).

X-ray Reports.—"October 15, 1932. a film of the pelvis shows the shadows of fourteen radium implants rather widely distributed.

"October 15, 1932. Another film including the lower half of the pelvis shows several additional radium implants. The bone of the right ischium appears slightly mottled in character. This is very suspicious of an early metastatic process."

The patient was discharged home, October 15, 1932. He was readmitted for deep therapy in February, 1933; 800 r units to the anterior and posterior pelvis.

X-ray Report.—"February 2, 1933. Examination of the pelvis at this time shows slight extension in the process of the right ischium. The appearance at this time is definitely that of a metastatic process. No other foci of disease appear in the film of the pelvis."

The patient was admitted again September 22, 1933. He had gained 13 pounds. There had been a gradual return of urinary frequency in the past few months, and there was a large fixed mass in the region of the prostate. Non-protein-nitrogen was 150 mgs. There was constant urethral catheter drainage. In October, 1933, deep therapy was administered: 600 r units each to the anterior and posterior pelvis.

X-ray Reports.—"September 25, 1933. X-ray examination of pelvis and lumbar spine: There is slight extension of the process in the right ischium, possibly early changes on the left side. The other portions of the pelvis and lumbar spine do not show any very definite metastases.

"October 21, 1933. X-ray examination of the chest: The diaphragm appears normal in position and outline on both sides. The lung fields are of normal radiance on the right, of somewhat diminished radiance on the left. No gross areas of consolidation."

There was gradual failure with signs of pulmonary and renal infection. The patient died December 10, 1933. The interval between the onset of symptoms and clinical demonstration of metastases was eight months. Length of life after demonstration of metastases was fourteen months.

Final Diagnosis (Autopsy).—Adenocarcinoma of the prostate, with metastases to lungs, liver, and peri-ureteral lymphatics; pyelonephritis, bilateral; pyo-ureter, left; hydro-ureter, right; pyophlebitis; bronchopneumonia; tuberculosis of lungs; hydrocele, right.

The body was that of a fairly well developed and extremely emaciated, elderly white male. Post-mortem findings were essentially negative other than scattered firm nodules in the apices of both lungs. The spleen showed a firm nodule of poorly demarcated, yellowish tissue with some central softening. Liver weight was 1350 gms. Numerous whitish or yellowish nodules, from several mm. to 0.5 cm. in diameter, were present. Many were necrotic in the center, others were cystic and filled with thin, bile-tinged fluid. The right kidney weighed 70 gms., left 260 gms. The right was essentially a large distended pelvis, thin-walled, and containing 40 c.c. of thin, clear

urine. The kidney substance had been compressed to 2 to 4 mm. in thickness. Calices were markedly distended. The left kidney was about twice the normal size. Capsule was adherent, leaving a pale, coarse, granular surface when stripped away. There was poor differentiation between the cortex and medulla. Numerous abscesses, 1 to 2 mm. in diameter, were scattered through different parts of the renal substance. Calices were dilated and the pelvis contained 35 c.c. of thick, creamy pus. Both ureters were dilated, the left to 1 cm. in diameter, the right to 0.7 cm. Walls were thickened, and scattered along their course were numerous nodules composed of homogeneous, gray, firm material. The bladder was small, walls thickened. Mucosa was red and covered with flecks of fibrin. The trigone was prominent, and just inside the sphincter posteriorly was an irregular broad flat elevation. The prostate was three times the normal size, densely adherent to the adjacent pelvic structures. The seminal vesicles could not be identified. The rectum was apparently not invaded. Section revealed numerous discrete grayish areas, the center somewhat necrotic. The iliac and para-aortic nodes were enlarged, gray and firm. Bone findings were grossly negative.

Microscopic Findings.—In some foci in the lungs, peribronchial lymphatics were invaded by cords and clusters of large polyhedral cells with darkly staining, granular cytoplasm and large, vesicular hyperchromatic nuclei. Mitoses were rare. The liver metastases were composed of similar cells. A section of bladder contained no tumor. The prostate was diffusely invaded by tumor cells and the normal acini were nearly entirely replaced.

Description of Large Sections.—Fairly large tumor masses were present in the lymphatics in the sphincter ani, and many lymphatics in the levator ani were distended by tumor to as much as 2 mm. in diameter. A few small tumor masses were present in the submucosa. Lymphatics in the outer muscle of rectum were invaded, in some places extensively and in others slightly. Small tumor masses were also seen in the submucosa above the level of the prostate, but above the seminal vesicles the rectum was free of tumor.

The prostate was diffusely invaded by tumor and there was extensive invasion of the capsule by masses which, in some foci, were large. Perineural invasion in some places was abundant, and in some was not very striking. It did seem to be of real significance, however. There were fairly large tumor masses between the prostate and rectum, seminal vesicles and rectum, and about the vesicles. Perineural invasion here was fairly extensive, but not constant.

The bladder showed much invasion inferiorly, posteriorly and some in the right lateral wall. The ureters were not invaded. In one section the outer part of the seminal vesicle was invaded.

Tumor was present in one section beneath the peritoneum of the pouch of Douglas, and there was much invasion of lymphatics about

the right vas and ureter, but this faded out soon. Perineural invasion was fairly extensive here.

There was no tumor in any of the bones, but in some of the sections of sacrum soft tissue anterior to the bone showed slight lymphatic invasion with some perineural involvement (number two and three of eleven bone sections), and in the sixth section tumor was seen in a small lymph node near the bone.

Case 8 (34-A-36).—An American laborer, aged sixty-four, was admitted to the hospital January 27, 1934. Less than two months before he began to complain of difficult voiding, increased frequency and dysuria, culminating in complete retention. There was a history also, of severe chest pain radiating down the left arm, dyspnea and edema. There was no loss of weight. Examination showed a poor general condition. The kidneys were neither palpable nor tender. The prostate was only slightly enlarged and of benign consistency. Cystoscopy revealed a marked elevation in the posterior bladder wall, not suggestive of tumor in appearance; very slight evidence of prostatic obstruction.

X-ray Reports.—"January 30, 1934. Examination of the pelvis shows some increase in the density of the bone in the region of the pubis and ischium on both sides. Suggest a lateral view of the skull before drawing any conclusions.

"February 8, 1934. Lateral view of the skull shows calcification of the pineal body. No evidence of disease in the bones of the vault. The cystogram shows defect in the right side of the bladder. Believe that the changes seen in the bone in the film of the pelvis are due to Paget's disease."

The patient failed rapidly; he was stuporous and irrational much of the time. Severe chest pain and signs of decompensation were present. Suprapubic drainage was advised but the condition of the patient would not permit operation. He finally developed bronchopneumonia and death occurred March 11, 1934. The interval between the onset of symptoms and discovery of metastases at autopsy was three and one-half months.

Final Diagnosis (Autopsy).—Carcinoma simplex of the prostate with metastases to bladder, pelvic and para-aortic lymph nodes, vertebræ and lungs; hydronephrosis and pyelonephritis, right; papillary adenoma of kidney; hypertrophy and dilatation of heart; congestion of lungs; pleural effusion; arteriosclerosis; duodenal ulcer; bronchopneumonia.

The significant post-mortem findings were: 500 c.c. of fluid in both pleural cavities; moderate cardiac hypertrophy, and bleeding duodenal ulcer. The right kidney contained two abscesses and the right ureter was slightly dilated. The left kidney and ureter were not abnormal. The bladder wall was much thickened and the mucosa ulcerated and

covered by greenish-black slough. Posterior to the internal urinary meatus was a fold of mucosa 1 cm. high fixed to the prostate and extending transversely across the bladder. The prostate was 5.5 cm. in diameter, very hard, and nodular, but not firmly adherent to the surrounding structures. The cut surface was yellowish-white and revealed invasion of the posterior part of the capsule. The para-aortic and pelvic lymph nodes were all enlarged, hard and adherent to surrounding structures. The lower abdominal nodes formed a large mass on each side of the aorta. The bodies of all vertebræ from the eighth dorsal to the fifth lumbar were replaced by tumor.

Microscopic Findings.—The tumor was made up of small clumps of closely-packed epithelial cells with oval, vesicular nuclei. Alveolar formation was rare. There were occasional mitotic figures. Numerous clusters of tumor cells were present in the lymphatic spaces of the bladder musculature. There were small foci of tumor in perprostatic fat.

Description of Large Sections.—Tumor was present in the bladder posteriorly near the prostate.

All sections of the prostate showed extensive tumor invasion with much lymphatic invasion in the capsule. There was much perineural lymphatic invasion, also. In one section a few veins were invaded.

The rectum and sigmoid contained no tumor and there were no tumor masses between the prostate and rectum.

Ureters, vasa and seminal vesicles contained no tumor.

There were no tumor masses outside the prostate. Many normal nerves and ganglia were seen lateral and posterior to seminal vesicles. A few small normal lymph nodes were seen here. Some sections of soft tissues above the bladder contained no tumor. In one, a small amount of tumor was seen in the lymphatics about one nerve trunk posterior and lateral to the seminal vesicle. Several sections included much enlarged, nearly or completely tumor-replaced lymph nodes beside the iliac vessels. In a few, tumor was also seen in a few lymphatics outside the nodes. One node in front of the sacrum contained tumor as did some lymphatics in the adjacent muscle.

No tumor was present in the coccyx. A section of ischium did contain tumor and tumor was present in the adjacent soft tissue. Some sections of sacrum contained no tumor, but others contained much. Within the periosteum of the upper half of the sacrum were many small tumor masses, some perineural. Many small tumor masses were also present just outside the periosteum and here, too, much of the tumor was perineural. Direct invasion of the bone was seen in several places.

DISCUSSION

These cases stress the importance of dissemination of prostatic carcinoma by the perineural lymphatics. All showed perineural

lymphatic invasion. In the control case chosen, an advanced carcinoma of the bladder, no perineural invasion was found.

Perineural lymphatics may be infiltrated and spread of tumor occur by permeation with maintenance of continuity, or rarely, as in Case 3, by lymphatic embolism. While it may be objected that this perineural involvement in our cases is a late feature due to widespread disease, its occurrence in early cases is well established. In practically all cases which we have studied, entirely aside from those in this series, perineural lymphatic involvement is an important factor. At times diffuse involvement of the nerve and surrounding tissue occurs.

One also receives a certain amount of indirect evidence bearing on nerve involvement from the frequency with which pain appears as an important symptom in prostatic cancer. Whereas hypertrophy of the prostate produces, as a rule, more obstruction to urinary outflow and more pressure on surrounding structures, nevertheless associated local pain is infrequent. In carcinoma of the pancreas, carcinoma of the breast, carcinoma of the skin, for example, pain is not a prominent feature until the tumor has reached a formidable extent. On the other hand, pain is common with carcinoma of the prostate.

This involvement of the perineural lymphatics is not a peculiar property of prostatic cancer, but a prominent feature because of the unusually abundant nerve supply in the prostate, its capsule and the adjacent tissue. Thus in an epidermoid carcinoma of the tongue, an organ where the nerve supply is abundant, one not rarely sees extension of the tumor along perineural lymphatics.

These periprostatic nerves are distributed widely, some running laterally towards the iliac vessels and thus coming in close proximity to the bony pelvis, and others passing along the perirectal soft tissues to the sacrum and lower lumbar spine.

The lymphatic channels from the prostate do not come into as intimate contact with bone as do the nerves, with their accompanying lymphatics, so that involvement of bone from regional or distant lymph nodes and their related lymphatic trunks would be more unlikely.[8]

It will be noted in the description of the slides studied that very little evidence was found of involvement of nerves or their lymphatics extending toward the bony pelvis. This was more or less

to be expected in view of the orientation of the section in the horizontal plane which made laterally spreading lymphatics or nerves much less likely to be seen than had they been running at right angles to the plane of section.

We wish to emphasize that true hematogenous bony metastases are present and that the perineural lymphatics offer an additional mode of access of the tumor to bone, which accounts for the marked frequency of pelvic and lower vertebral involvement as compared with regions more distant from the tumor.

We may regard, then, the perineural lymphatics as pathways leading the cancer into intimate contact with cortical bone. From thence, growth through the ostia is relatively simple and invasion of the bone follows. In these sections, as will be noted from the description, this direct invasion of bone has been repeatedly demonstrated. Its detection by x-ray examination is much more difficult and probably impossible. It was not made out roentgenographically in any of the present group of cases. However, Figures 9, 10 and 11 of Graves,[4] show a sequence of roentgenograms which strongly suggest direct invasion of bone from without, sweeping across the vertebral body.

Several interesting points with regard to x-ray diagnosis of bony metastasis of prostatic cancer developed. While it has long been recognized that metastases of carcinoma of the prostate may give symptoms before any x-ray evidence of their existence can be obtained, this study brings out a possible explanation for this point. Obviously, if the tumor is advancing along perineural lymphatics, then developing in the lymphatic plexus closely in contact with the periosteum and cortical bone, as our sections demonstrate, it is apparent that there will be a period when there is a considerable amount of pain from periosteal involvement without any definite disturbance of the bone itself. Only with the invasion of the ostia, and the growth into marrow spaces with the induction of changes in the bony trabeculæ, will there be changes demonstrable by x-ray examination. Just as pain is an early symptom in primary carcinoma of the prostate, so it may be an early symptom in its metastases.

The osteosclerotic nature of prostatic metastases has long been a cause for speculation. Our present study sheds no light on the reason for this type of reaction in bone, but the assumption is justified

that the slow growth of the prostatic metastases permits the pressure of the growing tumor to stimulate osteoblasts to increased activity rather than desroy those osteoblasts and their products.

Case 1 of this series is of particular importance in that it emphasizes a second source of error in x-ray diagnosis of metastases of carcinoma of the prostate. Not only may a positive metastasis be missed, but also, as in this case, regions of altered density in bone may be falsely interpreted as metastases. Some of the apparent pelvic metastases in Case 1 were confirmed by microscopic examination. Others, and the lesions in the axial skeleton, were found to be free from tumor and merely regions where there was variation in the thickness of the bony trabeculæ and the frequency of their occurrence. This may possibly represent an irregular resorption in a process of osteoporosis. There was no fibrosis to suggest the healing of a previously existent carcinomatous metastasis, but merely normal fatty marrow and thin, somewhat infrequent, trabeculæ.

Aside from the bony metastases, certain points regarding the extension of the tumor in the adjacent soft parts were brought out by this study and will be made the subject of a later report. Invasion of the bladder was frequent and extensive. The supporting structures about the seminal vesicles, the vasa, the ureters, were frequently involved in the tumor but actual invasion or replacement of the structures by tumor was extraordinarily rare.

Of particular interest was the high proportion of cases in which the rectum was involved. Here the perineural lymphatic pathway was an important factor in conducting the tumor from the periprostatic tissues into the rectal tissues. In several instances tumor cells could be demonstrated in the region of the myenteric plexus.

SUMMARY AND CONCLUSIONS

1. Seven cases of carcinoma of the prostate and one carcinoma of the bladder were studied by large sections through the soft tissues and adjacent bones of the pelvis. Perineural lymphatic involvement was a constant feature in the cases of carcinoma of the prostate, and was absent in that of the carcinoma of the bladder.

2. Owing to the abundant nerve supply in and about the prostate, opportunity for perineural lymphatic involvement is great.

3. The pain associated with prostatic cancer is clinical evidence of the existence of perineural involvement.

4. While hematogenous metastases may occur in carcinoma of the prostate, the chief factors in the marked preponderance of metastatic lesions in the pelvis and in the lower spine are the distribution of the nerves and the conduction of tumor along the perineural lymphatics into close contact with bone.

5. Many metastases occur as a direct invasion of the marrow spaces through the cortical ostia.

6. Early metastases may be missed in x-ray study. Conversely, under rare conditions metastases may be erroneously diagnosed, there actually being only an irregularity in the extent of bone resorption.

7. Invasion of the lymphatic channels is a frequent occurrence, and metastases by the usual lymphatic route an important factor in the spread of the disease, although probably not important in determining the localization of the bony metastases.

8. The perineural lymphatic dissemination of the tumor may be either by continuity or take place through embolism.

9. Involvement of soft parts, particularly rectum, seminal vesicles, vasa and ureters can be readily studied by this method and will be reported upon at a future date.

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EXPERIENCES WITH TRANSURETHRAL RESECTION IN CARCINOMA OF THE PROSTATE

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In a paper presented October 2, 1935, before the Pennsylvania State Medical Society, the writer reviewed cases of carcinoma of the prostate under observation over a period of twenty-five years. Such a critical survey leaves but one conclusion in one's mind, i.e., that we are dealing with an essentially fatal disease and that occasional enthusiastic reports of results obtained in isolated series of cases are either immediate results obtained by a certain method of treatment, or, they represent a group of cases that would react favorably to any method of procedure; the type of carcinoma, in fact, that would probably grow slowly, were no specific treatment employed.

Furthermore, little can be found in such a review from which to derive much encouragement as regards the results to be expected from any one form of specific treatment. Several years ago, C. H. Mayo made the statement that whatever one does for carcinoma of the prostate will be wrong. Experience, however, supplies a certain discrimination in classifying cases and acts as a balance in tempering one's enthusiasm for newer methods of treatment, as they appear from time to time.

The following procedures have been employed by the writer during the past twenty-five years, in attempts to effect a cure or to relieve symptoms in carcinoma of the prostate: suprapubic and perineal prostatectomy; excision, through a cystotomy opening, of the obstructing portion of the prostate, with the cautery, Rongeur forceps, or punch; permanent suprapubic drainage; surface applications of radium in the urethra and per rectum; radium needles inserted into the prostate, through the perineum, or through a suprapubic opening; roentgen therapy; diathermy; transurethral operations consisting of fulguration, punch operations, and latterly transurethral resection; while, in a certain number of cases no specific treatment was instituted.

This array of procedures, all of which, doubtless, have been em-

ployed by many urologists, is in itself an indication of the inadequacy of any one procedure as a means of cure or of obtaining symptomatic relief.

One of the great difficulties associated with the management of carcinoma of the prostate is the late appearance of symptoms, resulting in delayed diagnosis. Due to the frequent origin of carcinoma in the posterior lobe of the prostate, and more rarely, as has been recently demonstrated, in the center of hypertrophied lateral lobes, urinary symptoms caused by an extension of the growth, resulting in interference with bladder function, frequently appear only after the disease has become well advanced; as a rule when the prostatic capsule has become involved and the growth has extended to the seminal vesicles and bladder base.

This, I am sure, has been the common experience of urologists; consequently we seldom see a growth at a stage when it is sufficiently limited to warrant an attempt completely to excise the prostate, although Young has enthusiastically advocated such a procedure.

That certain types of prostatic carcinoma grow slowly is a well known fact, and in this type of growth, patients may live in comparative comfort for periods even of years. At the present time, the writer has under observation four cases which, for periods of ten, eight, seven, and three years have harbored a carcinomatous prostate, during which time there has been but little change in the character of the growth. Only during the past few months have two of these patients shown signs of a rather rapid extension of the growth, and evidence of metastasis, but neither case has more than an average of 2 ounces of residual urine, and but slight dysuria. The extension of the growth, in all four cases, has been toward the periphery of the gland, rather than intravesically.

One patient treated fifteen years ago by radium needles introduced into the prostate through a suprapubic cystotomy opening, also through the perineum, as well as by surface applications per urethra and per rectum, is alive and well, and has complete bladder function. This patient was last seen six months ago, at which time he was in excellent health.

Three patients from a series of seven cases reported before this Association in 1929, in which carcinoma was discovered on microscopic section, after a prostatectomy had been carried out, are now

well, ten, nine and seven years after operation. Two others succumbed to cardiac failure five and three years postoperative, neither having a recurrence at the time of death. In these cases, carcinoma was found in the center of large hypertrophied lateral lobes; in only three of these seven cases was the presence of malignancy even suspected before operation. Four other cases have since been added to this group having a prostatectomy for hypertrophy, carcinoma being found on microscopic section. These last four patients lived six years, four years, two years and nineteen months.

One patient is alive thirteen years after the introduction of radium into a single carcinomatous nodule in the prostate. This patient also developed carcinoma of the breast which was treated in the same manner.

These are exceptional cases among a series of fifty-nine treated to May, 1932. Prostatectomy was found to be unsatisfactory except in the cases above mentioned, in which the carcinoma was well incased in hypertrophied lobes. Suprapubic cystostomy drainage was disagreeable, painful, and difficult to maintain. One patient is alive after five unhappy years of drainage; two others died in six and five months. Radiation, except in the incidence of limited nodules, was followed by intense toxemia, and in but one instance was urinary retention relieved. No treatment, in isolated cases without retention, was, I am sure, the proper procedure in the four cases already mentioned. Those growths reacting favorably to radium, to surgery, or to no treatment, were undoubtedly of the slow-growing variety that might do well under any type of treatment. On the whole, the experiences of the writer during this period gave rise to the opinion that, in the majority of instances, the less done for carcinoma of the prostate, the better, until obstruction presented; and then, that operative interference should be limited to attempts to relieve the urinary retention.

It was with this background that the writer, in May, 1932, took up transurethral resection as a means of obtaining relief for prostatic obstruction due to carcinoma.

Since that date, sixty-three resections have been carried out on fifty-two patients, with no operative mortality, and 12 subsequent mortalities.

The late mortalities have resulted, nine from general metastasis, one, twelve months after resection; two, eighteen months; one,

twenty-two months; one, twenty-three months; one, twenty-six months; one, thirty months; one, three years; one, forty-four months. Three patients died of cardiac disease—two, one year, and the third two and one-half years after resection.

Forty patients were alive and had satisfactory bladder function when last heard from over a period of from one month to four years after resection. The ages of the patients resected, varied from forty-five to ninety-seven years; all had a residual varying from one ounce to complete retention. Those with a comparatively small amount of residual had marked frequency, dysuria, and hematuria. No radium was employed in any of these cases, and deep x-ray therapy only in an attempt to control hemorrhage before operation. In none, did the growth recede under roentgen therapy, and in two the urinary symptoms were aggravated.

In every case of carcinoma of the prostate with retention, seen during the past four years, whether metastases were present or not, resection has been carried out, and urinary function restored. In every case it was possible to pass the resectoscope after sufficient dilatation of the urethra. With the removal of the obstructing tissue, it was noted at the time of resection that there was little tendency for the remaining gland which was firm and fixed, to fall into and occlude the vesical orifice. With the orifice well freed of the encroaching growth, it has remained open, certainly for an appreciable length of time; as to date only three patients have required re-operation—one for severe hemorrhage which was controlled by another resection, and the other two for a marked increase in the size of the remaining growth. One of the latter was recently reoperated on in another city. Nine of the early patients resected required a second resection before they left the hospital. The amount of tissue removed varied from 4 to 56 grammes.

Four cases have been included in this group, although the pathologic report was negative for carcinoma. Clinically, these cases were typically carcinoma; in each instance the gland was stony hard, nodular and fixed; in three, the growth involved the vesicles and bladder neck. Undoubtedly, in these cases, the growth predominated in the periphery of the gland, and the area from which the sections were removed was not extensively invaded with carcinoma. The loop resectoscope was universally employed, which instrument, I believe, is preferable to the punch in cases of carci-

noma. When a strong cutting current is used a deeper destruction of tissue takes place, which, in the instance of carcinoma, is desirable. This complete cauterization may in certain instances mask the microscopic picture in the sections removed. Hemorrhage has seldom been a troublesome complication of resection in cases of carcinoma.

There seems to be less shock associated with resection for carcinoma than when resection is employed for hypertrophy.

Infection is a complication to be dealt with, especially in the instance of large growths, many of which cases have a pyelonephritis. Acidification of the urine and the administration of urinary antiseptics are beneficial.

With the re-establishment of bladder function and the ability of the patient to empty the bladder, tenesmus, dysuria, local congestion and infection subside. If pain in the perineum and legs has been present, this usually diminishes.

In six instances, a tumor of the bladder, either adjacent to, or independent of the carcinoma of the prostate, was removed by resection at the same time as the prostatic resection. Four of these patients are at present free of bladder growth, and in the two others the tumor is under control, small recurrences being eliminated as they have appeared.

In cases of carcinoma of the prostate, one obviously does not, by resection, remove more than the obstructing portion of the gland, although the destructive effect extends well beyond the cut surface when a strong cutting current is employed.

In no instance has the growth appeared to be stimulated by the resection, nor has an extension locally, or by metastasis, been accelerated, as has been suggested by some writers.

In the instances of small, hard, nodular, fixed glands, as well as large growths involving the capsule, vesicles, and even bladder wall, symptomatically, the results obtained over a period up to four years have been more satisfactory than from any other procedure employed up to the present time.

In comparing the results to be obtained from open operation, resection, or radiation, one must realize that circumscribed growths, often slow-growing, may respond favorably to any form of treatment, or do well for a considerable period of time when left alone, while resection and often radiation are employed in all types of

carcinoma with retention, most often in advanced cases, which would not be considered as suitable for a radical prostatectomy.

While one should have an open mind regarding the possible benefits to be derived from each method of treatment, and, in the light of broadening experience, select, without prejudice, the procedure which gives promise of the best chance of relief to the individual, one should also be mindful of the fact that certain operations may readily prove to be mutilations; that through extensive surgery the growth may become activated and generalized, and that in certain instances no treatment may be the most warranted and humane procedure.

Certainly, in resection, a procedure has been added to our possibilities which gives much comfort without extensive surgery. Only time will reveal how enduring this relief will prove to be.

SUMMARY OF OVER TWENTY-SEVEN THOUSAND CASES OF TRANSURETHRAL PROSTATIC RESECTIONS

CHARLES H. CHETWOOD, M.D.

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My communication to this meeting is not as imposing as the title implies, nor is its purpose to present anything original upon the subject, but having had early association with the study of the different phases of prostatism and having contributed in a small way toward the development of its surgical technic, I have retained an unfailing interest in the growth of the present methods of transurethral operation. To what extent this modern technic has been exploited can not be appreciated from any casual observation.

At a recent meeting of the New York Urological Association, Alcock ably presented a paper which represented a personal list of 1,400 operations by the transurethral method of prostatic resection covering a period of four years. In the discussion Randall called attention to the fact that Freyer, of London, whose prostatic surgery was drawn from the whole British Isles as well as part of the European continent, had reported before his death about 1,600 cases of prostatectomy after twenty years of practice, and Hugh Young had recently attained his two thousandth case of prostatectomy after thirty-five years. This contrast can be interpreted according to one's own point of view. It was somewhat later that a young medical man from the South entered my department and stated that he came to see as many as possible of the operations of transurethral resection. When told by one of my staff that we were not in any sense headquarters for that particular operation his reply was, "We all do a lot of them down my way, I just had one hundred cases myself." And this young man was of the House-Surgeon-period of his medical career. On the strength of these observations I was moved to make a somewhat widespread survey of the field in general. The result of this survey is the subject of my communication here, and he who runs may read.

A short questionnaire was prepared consisting of five questions, as follows:

TRANSURETHRAL PROSTATIC RESECTIONS

REPORTS RECEIVED FROM 800 INQUIRIES ~ 300 ANSWERS

37 STATES AND CANADA ~ FIELD AT LARGE

GROUP I

	TOTAL UNCLASSIFIED		
	CASES	MORT.	OPER'S
NEW YORK	3,372	87	42
PENNA	2,073	110	19
CALIF	1,830	79	17
ILLINOIS	1,652	65	16
TEXAS	1,588	49	14
MISSOURI	1,487	26	9
COLO	1,375	54	8
OHIO	1,360	53	15
TENN.	1,095	51	10
MICH.	956	31	8
INDIANA	902	20	7
WASHINGTON	807	22	5
CANADA	777	26	6
WISCONSIN	732	39	7
MASS.	681	23	12
LOUISIANA	611	17	2
NORTH CAROLINA	530	18	5
NEBRASKA	526	23	5
VIRGINIA	496	14	3
OREGON	452	23	3
GEORGIA	445	18	4
KENTUCKY	430	11	4
MARYLAND	415	13	4
OKLA	304	19	3
MINNESOTA	277	14	3
NEW JERSEY	270	11	3
FLORIDA	262	9	3
VERMONT	250	4	1
RHODE ISLAND	227	7	3
IOWA	220	20	5
SOUTH CAROLINA	175	3	2
ARIZONA	175	3	2
D. C.	161	8	5
UTAH	150	2	3
KANSAS	133	6	2
DELAWARE	91	6	1
CONN.	70	1	2
NEVADA	40	1	1
GRAND TOTAL	27,397	986	260

SUMMARY AND SUBDIVISION

30.7% — SELECTED CASES of 8,319 — OPERATORS ~ 84 — MORTALITY ~ 107 = 1.3% — SATISFACTORY 87% — UNSATIS. 13%

OPERATIONS FOR MINOR LESIONS (SMALL CONTRACTURES, SMALL LOBES) LIMITED TISSUE REMOVAL

COMPLICATIONS REPORTED BY 81% OF OPERATORS NONE BY 17%

14.1% — NON-SELECTED CASES ~ 3,867 — OPERATORS ~ 48 — MORTALITY ~ 348 = 9.0% — SATIS. 91% — UNSATISFACTORY 9%

OPERATIONS WITHOUT REGARD TO SIZE OF GROWTH (MEDIAN OR LATERAL LOBES)

COMPLICATIONS REPORTED BY 100% OF OPERATORS

48.2% — PARTLY SELECTED CASES ~ 13,210 — OPERATORS ~ 99 — MORTALITY ~ 511 = 4.0% — SATISFACTORY 85% — UNSATIS. 15%

COMBINING BOTH PREVIOUS CLASSES (OPERATORS AFTER EXPERIENCE, SELECTED CASES)

COMPLICATIONS REPORTED BY 91% OF OPERATORS; NONE BY 3%

7.0% — EXCLUDED CASES ~ 1939 — OPERATIONS ~ 27 — MORTALITY ~ 20 = 1.5%

100.0%

UNDER TEN OPERATIONS AND NON-CLASSIFIED

OPERATORS

GROUP II

	Operations	Mortality
Cecil, J.E. (Jl. Surg. Obst., Feb., 1934) - reports		
Transurethral Resections (punch cautery) mixed types	900	1.0 %
Results 'entirely satisfactory' Postoperative complications rare		
(a) 1910 Survey of work by 244 surgeons (punch cautery and high frequency current)	15,488	5.6 %
Various complications encountered by both methods, more with high frequency		
Comment: Transurethral Surgery to be safe - 'should be limited to use by those qualified by training and experience in its performance'		
Veeck, H.H. (Jour A.M.A., June 9, 1934) - reports		
Transurethral Resections (upper techne)	600	0.5 %
No statement of complications		
In advanced cases of hypertrophy, prostatectomy (perineal) preferred		
McCarthy (Penn. M.J., Aug. 1933)	125	0.8 %
Mayo Clinic (B.J. Thompson, Mar. 23, '34.) - reports		
(by more than 7 surgeons)	2,700	0.97 %
Nearly 2000 of these since January, 1932. Complications of minor degree. Only extremely large prostates subjected to prostatectomy		

GROUP II

	Operations	Mortality
Fleischner, H.L. (South. M.J., Mar 1935) - reports		
Transurethral Resections, no selection of cases	951	3.26 %
Results gave unqualified satisfaction		
Davis, T.M. (Oral and Colon Rev., June, 1935) - reports (for 7½ years)	748	0.879 %
Transurethral resections (mixed types)		
Complications few, serious sequelae rare. Results most satisfactory		
Comment: Operation highly technical, should only be undertaken by those sufficiently skilled and equipped to properly perform resection		
Alcock, W.E. (Jour A.M.A. March 2, 1935)		
Prostatic Resections - various types	600	4.6 %
Infection serious and frequent complication in earlier cases, also principal cause of death		
Comment: Satisfactory results determined by long experience and dexterity of operator		
1910 (N.Y. Urolog. Society Dec. 1935) - reports (including surgery)	1,400	3.9 % Avg.
Mortality percentage, minimum 2 % - maximum 15 %		
Number includes large prostates and those resected by more than one operation — impressively frank		
Grand Total Group II	22,512	4.9 %

PROSTATECTOMY

GROUP III

Young, H.H.	(Practice of urology) - Perineal prostatectomies	1,049	3.4 %
	Supra-pubic	130	6.2 %
Hunt, V.C.	(Canad. M.J. (7-1927) - Operations at Mayo Clinic 1926-1927		
Supra-pubic prostatectomies	one stage 783, mortality 4.3 %		
	two stage 212 - 3.7 %	995	4.2 %
Mayo, C.H.	(Mayo Clinic Collected Papers 26-1934) - Perineal prostatectomies	700	5 to 7 %
Randall, A.R.	(N.Y. Urol. Soc., Dec. 13, 1935 discussion) Supra-pubic prostatectomies	268	4.8 %
	Grand Total Group III	3,142	4.5 %

1. Approximately how many transurethral prostatic resections have you performed?
2. Has the result been satisfactory to you and the patients?
3. (a) Any mortalities? (b) How many?
4. Any complications?
5. What period covered?

Any comment?

The object of this investigation was to make a survey of the scope of the work in this line performed in the field at large in comparison with that which was done by those who were more especially identified with the development and growth of this operative technic. To obtain the desired information, the questions were mailed to 800 members of the American Urological Association. The result of this investigation is shown upon the chart which is compiled from the collected information. The comparative figures are obtained from the reports of members of this association who, from special experience with this operation, are conspicuous among its exponents: Young, Caulk, McCarthy, Kretschmer, Davis, Alcock, and the Mayo Clinic. About 800 inquiries were mailed and over 300 answers were received. Of the 300 replies, there were 260 that reported transurethral operations.

The graphic exposition in Chart I speaks for itself; it does not extol unqualifiedly or discredit the operation in question. It may not be possible to interpret or analyze the figures of such a chart with the brief information afforded therein and, therefore, it is not complete in this respect, but a large accumulation of material always tells something and it *does* show the numerical extent to which this method of treatment has expanded. My personal reaction is contained in the trite maxim, "a place for everything and everything in its place." Applying this maxim to the question of treatment of prostatism, I find that I have not changed my views from those expressed at the beginning of my study of this subject: **that lobular enucleation of the prostate has its appropriate indication as an operation of expediency as well as of necessity.** In the earlier period we knew about as much concerning the character of and variations in the lesions attacked as we do today, the difference being in the means of attacking them. Prostatectomy was then, as it is now, the most radical means of procedure and any other method sought to avoid the necessity of sub-total removal of the gland.

CHART I

Mortalities:

27,397 operations (all classes of cases).....986 deaths

	Per Cent Maximum	Minimum
1 to 100	16	0
100 to 200	10	0
200 to 400	7.5	0
400 to 600	11	0.5
600 to 700	6	0.5

Causes of Mortalities:

No cause given..... 822

Probably divided between hemorrhage and infection which are the largest number of causes reported.

Other causes named..... 6

Bladder perforation	1
Rupture of bladder	1
Embolism	1
Pyonephrosis	1
Explosion during operation	2

Complications:

Reported by 98 per cent of operators. (None by 2 per cent.)

A. Most common:

Hemorrhage of variable amount from a controllable degree to that requiring suprapubic cystotomy.

Infection, local and general, from simple pyuria to cellulitis and gangrene, locally; and, systemically, to septicemia and death.

B. Other complications enumerated of lesser number:

Urinary extravisation.
Pyelitis
Pyelonephritis.
Uremia
Thrombosis.
Chronic urethra-cystitis.
Stricture.
Incontinence.
Epididymitis.

It is a matter of history that the early procedure of attacking the prostate through the urethra was with a galvano cautery knife, devised by Bottini and Freudenberg, and the unfavorable results are also a matter of history. It was after that time that I suggested and practiced a technic with the same purpose of removing the obstructing portion of the bladder neck with a galvano cautery knife, but with what was considered the important addition of a perineal button hole opening to permit tactile examination and to provide adequate surgical drainage. The fact that infection is one of the most prevalent complications of the present method is a justification of such surgical provision, but as is the experience in all novel innovations, the tendency was to employ this means beyond its warranted application and it was soon learned its indication was a limited field. I believe that the same principle in-

volved in the experience of the past should be applied to the present situation and that caution, as well as restraint, should be exercised in this modern practice which, most urologists will agree, should be applied to a selective class of cases.

The great advancement in the manufacture of electro-surgical instruments, while giving great efficiency to the use of such instruments, unfortunately, places them in the hands of the inexperienced and the temptation to try out such instruments is like that which impels one with a new high-powered automobile to scorch the road. That transurethral prostatic surgery is here to stay cannot be questioned. That its limitations should be thoroughly determined demands frank and full discussion and an unbiased report of complications and end-results. It is not the intent of this present contribution to set forth what the limitations should be.

Respecting the percentage of cases to which it is adaptable it is variously claimed to be 75 to 98 per cent and even 100 per cent. Seventy-five per cent would be a notable achievement, 98 per cent doubtful, 100 per cent a *panacea,* which it is not. And, as is frequently the case when we think we have Utopia, we learn that *"magic casements open upon the foam of perilous seas."*

DISCUSSION

DR. ARTHUR H. CROSBIE (Boston, Mass.): I have enjoyed all three of these papers a great deal. I just want to say a few words about Dr. Bugbee's paper. I would like to say that I agree with him entirely in his views. I have always been impressed with the slowness of growth, as a general rule, in prostatic carcinoma.

Dr. Bugbee pointed out that frequently it gave an erroneous idea regarding any type of treatment that you use. For a great many years, Dr. Chute and I, in handling prostatic carcinoma with obstruction, used the perineal prostatectomy, really just did a partial prostatectomy, enough to give relief of the obstruction. But that operation was enough so that in a great many cases a man was relieved of his obstruction until he went on and died of some other disease, sometimes eight or ten years afterward.

Now four years ago, we started resecting the cases of obstructing carcinoma of the prostate. During my absence, Dr. Chamberlain carried on the same work with very good success. I have done it several times since I came back. We have found that the operation often has to be repeated. I know of one case that Dr. Chamberlain has followed for about four years where, about once a year, this man comes back and has a resection. Then he is able to empty his bladder and goes on for another year. I feel that it is a very satisfactory way of relieving obstruction from carcinoma of the prostate.

DR. BENJAMIN S. BARRINGER (New York, N. Y.): Dr. Graves has made a very notable contribution to the subject of the way in which metastases go from the prostate to the lumbar spine and pelvis. I confess that while they were supposed to go by the vascular system, I don't know of any set of vessels which goes from the prostate directly to the pelvis or the lumbar spine. They all go by way of the iliac vessels. I think Dr. Graves' work indicates they may go through the perineural lymphatics.

On the other hand, it does not explain the very definite clinical idea that I have, that cases with osseous metastasis do not have pain as a rule. The cases that have pain have perineural metastases

formed in some way, I presume, by direct extension. So I still remain puzzled about osseous metastases.

Dr. Bugbee gave a very fine résumé of the entire subject of carcinoma of the prostate. I believe that we can control from 5 to 10 per cent of all cases for five years. That is, when I say control, I mean that apparently those patients had no carcinoma, were well, had no cystoscopic evidences of it. On the other hand, it is extraordinary how we are fooled by such patients. I had one patient who was totally well for six years. Palpation and cystoscopy didn't reveal any evidences as far as I could see; yet he had retention which I thought was a fibrosis of the bladder neck. I did a transurethral resection and in the specimen found remains of carcinoma of the prostate after six years of treatment by radium.

I don't hear, at this meeting, any talk about the aspiration biopsy. I believe that is a very valuable procedure. I think it helps us enormously in making an early diagnosis; it is successful in 80 per cent of cases. You don't have to have any particularly fine set of needles as long as they are long enough. I have done the aspiration with spinal needles and with almost any sharp needle. I think the diagnosis can be made in the large majority of cases.

I remember well a case of Beer's in which we both felt a large lump in the prostate. I aspirated that lump, and we found no carcinoma. Now, four years afterwards, he still has the lump and has no carcinoma and he is still the same as he ever was. I think it helps, in a large number of cases, to make an early diagnosis. Of course, in most cases it isn't necessary. I think Dr. Bugbee's suggestion of resection followed by some form of irradiation helps. That is, I mean it probably helps in keeping the bladder emptying itself for a longer period of time.

I think we are all troubled terribly by the cases of resection that have perfectly good results for six months or a year and then relapse. I believe if some sort of irradiation is given, that somehow slows down the carcinoma or somehow devitalizes it around the bladder neck so that resection is more satisfactory. I presume a moderate form of external irradiation is best for that purpose.

Dr. T. M. Davis (Greenville, S. C.): I enjoyed the three presentations very much. I was very much interested in Dr. Bugbee's experience with carcinoma of the prostate. My experience with

carcinoma of the prostate and resection has been that a small-sized gland not causing a great amount of trouble, which the patient can, with reasonable comfort, endure had best be left until it gives sufficient trouble to cause a demand for relief, because those glands, if resected, have a tendency to increase the rapidity of their growth, and if not resected they do go longer than if they are tampered with.

In the larger types that are causing obstruction and demand relief, I think resection is the ideal method of procedure. I don't agree with Dr. Bugbee in using a high-powered current and causing cauterization of the tissue and leaving cauterized tissue *in situ*. I think the best thing to do is to cauterize early in the game. I used to cauterize with a cauterizing current and thought I was doing some good. I doubt that I did, and I think if you resect the carcinoma as clean-cut as you can, control the hemorrhage and give the patient x-ray irradiation afterwards, that is the best plan of procedure. It gives me the best results.

As to Dr. Chetwood's recitation of this method, I agree with Dr. Chetwood that enucleation of the gland is the best method of choice, but I don't agree with him as to the method of enucleation. My observation and discussion with members, who are doing resection, gave me to believe that they are not removing a sufficient amount of tissue to get the desired results. You can do as complete a prostatectomy with the resectoscope as you can with opening the bladder on the perineum, and I think that is the method of choice in treating the benign hypertrophy. The gland can be removed down to the capsule; you can recognize the capsule, you can definitely differentiate between capsule and prostatic tissue and you can completely remove the prostate by transurethral resection. I think it is not the limitation of the procedure, I think it is the selection of the individual operator and not selection of the procedure in removing the prostatic tissue that is important.

DR. WILLIAM F. BRAASCH (Rochester, Minn.): Our results following the punch operation in carcinoma of the prostate gland are about the same as those of Dr. Bugbee. It must be said, however, that the improvement in subjective symptoms with most patients who have had a punch operation or resection for carcinoma is not as great as with benign obstruction. Many of these patients

have returned after resection with a story of continued irritation at the bladder neck and with a dysuria and frequency.

Histologic examination of tissue removed by resection frequently reveals the presence of carcinoma in cases in which rectal examination indicated benign hyperplasia. Those who claim to diagnose carcinoma by rectal palpation in all cases will have to revise their attitude. It has been impossible to recognize or even suspect carcinoma on clinical examination in many cases. The use of the diagnostic needle, which Dr. Barringer recommends, has not been as satisfactory in our hands as he claims. Our technic was probably at fault. In those cases in which it was used there were many failures.

Gradation of malignancy in the tissue removed is of distinct value in prognosis and should receive more attention. It is true that exceptions to the rule may occur and a patient with a grade 1 or 2 malignancy occasionally lives but a short time. In the majority of cases, however, a patient with a grade 2 or less will live much longer than the one with a grade 4.

Speaking of longevity with carcinoma, I would like to cite a case which Dr. Crenshaw examined fourteen years ago. This patient, at that time, gave a history of urinary obstruction of two years' duration. On rectal examination the prostate gland was described as hard, firm, and nodular, and the diagnosis was carcinoma (90 per cent). I reëxamined this patient three weeks ago, and found him to be in excellent condition, although recent symptoms suggested rapid growth of the prostate gland. There was residual urine amounting to 100 c.c.

Although our experience with prostatic resection by means of the loop has not been extensive with prostatic carcinoma, we gained the impression that we had less postoperative trouble with the cold knife punch.

Dr. Bransford Lewis (St. Louis, Mo.): I participate in the admiration of Dr. Bugbee's review. I think it is a very sensible and conservative presentation. I have never been a convert of the attempt at radical removal of the carcinomatous prostate. I rely on two methods, resection and radium implantation, which, I think, have their place and are both highly beneficial. As Dr. Barringer says, such patients can be carried along by a judicious

application of these methods for three to five years, which is a considerable length of time for obtaining comparative comfort for these carcinomatous cases. In addition to the resection which, I think, has its application in the obstruction features of carcinoma only and I don't believe it has an application just because of the carcinomatous prostate there, we have the use of the emanation radium needles through the perineum, which, to my mind, is very efficient and beneficial. I recall some cases in which the whole carcinomatous picture was present, the lowered vitality, the patient going down, and it looked as though he were going to the grave with a large carcinomatous process. The use of emanation needles reduced the size of that prostate to an astonishing degree. The patient was carried on for at least three years, went back into his work of traveling employment and derived great satisfaction from it. Those two applications, I think, are serviceable and I wouldn't rely either on the one or the other to the exclusion of the other.

Now, Dr. Chetwood's review is vastly interesting. He shows that prostatic resection is being stabilized, that it is being estimated properly, where it should have been in the first place instead of the grand hullabaloo that was put over for it and in which they said there was no mortality, no grief, "no hits, no errors."

Now, this must be remembered, that the mortality of prostatic resection is not standardized by these experts, Bumpus, Gershom Thompson and Caulk and others. That doesn't represent the mortality of prostatic resection; that represents the mortality only of experts, which does not represent the general mortality of the operation throughout the country. That was one of the mistakes that was first made when some of these enthusiasts said it had no mortality. It had a very surprising mortality, as we brought out in our paper of 1933.* We never took exception to the operation. Our criticism was never against transurethral resection but was always against the misrepresentations of that time.

DR. EDWARD L. KEYES (New York, N. Y.): I have already fought a losing battle with the New York State Health Department because they said, flatly, that all prostatic carcinomatous patients die with or of prostatic carcinomas.

All early carcinomas in the prostate, or anywhere else, are cur-

*Lewis, Bransford, and Carroll, Grayson: Prostatic resection—without the moonlight and roses. Urol. and Cut. Rev., (January) 1933.

able, only we happen not to be good enough men to cure them all. We do not diagnose them early enough.

One may urge upon Dr. Braasch, for instance, a renewed hope that he may find someone in his department skillful enough to get a high batting average of accuracy with the aspiration biopsy so that he can get a diagnosis earlier, for quite obviously, what he and the others and Dr. Barringer have said is true, that by rectal palpation you can't diagnose carcinoma of the prostate early enough to cure it in any appreciable number of cases. Dr. Young's 4 per cent, Dr. Barringer's 5 to 10 per cent, I would permit myself to think, optimistic as I am, isn't a large percentage of cures. Dr. Barringer said aspiration biopsy is an easy thing to do; you take a spinal needle and stick it in. On the contrary, it is a difficult thing to do well! I can't do it. The twist and the turn that is required to get out a decent specimen is difficult. In our clinic, we have enthusiasts, and *per contra,* others who are not so enthusiastic. The most healthily sour-minded person among the residents and interns tells me that he thinks with us that we can confirm an aspiration biopsy specimen from the prostate as being carcinoma in about one-third of the suspected cases, negative in one-third and doubtful in another third. One may hope that five years from now, nobody will say that all patients with carcinoma of the prostate die.

DR. NATHANIEL ALCOCK (Iowa City, Iowa): I agree entirely with what Dr. Bugbee has said about carcinoma of the prostate, in every way. We thought for a while that we were getting somewhere with x-ray treatment and in a very small percentage of the cases we did get good results. But the percentage was so small that we have become very much discouraged. The reason for my coming up here to the front to speak was to correct two things or to explain one thing and correct another. That is this matter of where these 1,400 cases come from. All I have to do to explain that is to repeat some of the figures. There were 1,400 cases reported in New York in December. There were sixty-nine patients who were below the age of sixty (4.5 per cent). There were 9 per cent over eighty, and there were 62 per cent, or 63 per cent, over seventy.

Now, that should speak for itself, that those were patients who

needed something done to their prostates. We have not been doing prophylactic prostatectomies and we have been very careful, almost leaning over backwards, in not doing resections on patients who did not need them. Where they came from I do not know, except that practically all of them came from the state of Iowa. One did come from New York. We had not operated on any of the bad ones, and 17 per cent of the patients who came we sent home because we didn't think they needed anything done.

Another thing I want to correct is the statement that the mortality rate increased because I had my interns do the operation. I do not want to make this statement as an alibi with regard to my mortality rate because that is not true. None of my interns has ever done a prostatic resection. The assistants did do them and are doing them, but the assistant doesn't do them until he is in his third year of training, and preceding his beginning with me, he has two years of internship. During that time he has quite a large experience in cystoscopic work and in surgery. Transurethral resection is the last surgery that he attempts and we start him by having him start the small ones and somebody else finishing them up, and we are very, very careful in doing that.

I do not want to offer an alibi for my mortality rate by saying that that was the cause of it, although I do know that your mortality rate will be high when you begin. The mortality rate in prostatectomy, the mortality rate in prostatic resection is exactly in proportion as you select your cases. If you take the very old ones and don't take the young ones, it is going to be high. If you take the young ones with 36 per cent of them under sixty, naturally it is going to be low.

DR. ROGER C. GRAVES (Boston, Mass.): I want to express, at this time, the pleasure that I know we all feel in having Dr. Crosbie able to be back with us and take part in our meeting. (Applause.)

I also wish to thank very much Dr. Bugbee and Dr. Chetwood for their papers, which I enjoyed.

DR. CHARLES H. CHETWOOD: I haven't anything really to add but I must reply to Dr. Davis, who seems to use the term "enucleation" as I hadn't understood it to be used for resection. In using that term, I mean lobular enucleation and not resection. I, per-

sonally, can do an enucleation quicker by prostatectomy than by resection, therefore, I prefer to do it that way.

To. Dr. Alcock I owe an apology, if I have misquoted. I had the transcript of the minutes given to me and I was not able to get hold of Dr. Alcock's paper, so I quoted from the transcript of the minutes. But if I have misquoted him, I abjectly apologize, and I will add, also that when I come to the state of mind of needing a resection, to use the words of Dr. Gilbert Smith, I shall certainly have Dr. Alcock do it for me. I have nothing further to add. I think I said in my presentation that "he who runs may read." I might summarize by saying, "We who read may run."

A HISTOPATHOLOGIC STUDY OF THE FEMALE BLADDER NECK AND URETHRA

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Comparatively little attention has been given to the study of the female urethra. The general practitioner has regarded it merely as a short outlet through which the bladder empties itself. A review of the urologic literature reveals few investigations of the urethra and bladder neck in the female.

Since Folsom and Renner, in 1931, independently introduced into the clinical journals the term, "female prostate," a new conception of the term "prostate" is slowly gaining foothold in the American literature; and further histopathologic studies are indicated.

Our work proceeds on the following outline:

1. Embryology of the urethra and male prostate.
2. Review of the literature on the female urethra and bladder neck.
3. Cystic disease of the urinary tract.
4. Personal work constituting a comparative study of thirty specimens of bladder neck and urethra in adult females over forty years of age, with seventeen similar specimens of children under four years of age.

EMBRYOLOGY

We have briefly reviewed the comparative embryology of the lower urinary tract in both sexes including only those features which are pertinent to our question.

Arey mentions that in embryos of 1.4 mm., the cloaca, a caudal expansion of the primitive entodermal canal, is in contact ventrally with the ectoderm, and the area of union constitutes the cloacal membrane. The saddle-like partition between the intestine and the allantois grows caudally, dividing the cloaca into a dorsal rectum, and a ventral, primitive urogenital sinus.

The division is complete in embryos of 11 to 15 mm., and at the same time the partition, fusing with the cloacal membrane divides it into the anal membrane of the gut and the urogenital membrane. At 11 mm., according to Felix, the primitive urogenital sinus by elongation and constriction is differentiated into two regions: (1) a dorsal vesico-urethral anlage which receives the allantois and mesonephric duct, and is connected by the con-

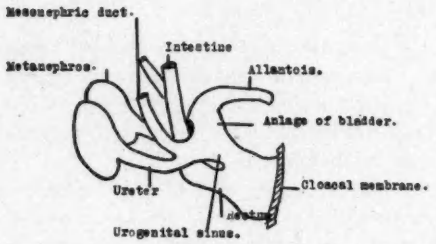

Fig. 1. Reconstruction from a 12 mm. human embryo, showing the partial division of the cloaca into rectum and urogenital sinus. (Modified from Pohlman-Prentiss.)

striction with (2) the phallic portion. The latter extends onto the phallus of both sexes.

The vesico-urethral anlage enlarges and becomes the bladder and the entire female urethra, or the prostatic and membranous urethra in the male. The ureters shift their openings from a dorsal to a lateral position, in the vesico-urethral anlage, lateral to the mesonephric ducts. The lateral walls of the bladder anlage grow more rapidly than its dorso-median urethral wall; hence the ureters are carried cranially and laterally upon the wall of the bladder, while the mesonephric ducts open close together on a hillock (Muller's tubercle) into the dorsal wall of the urethra. Thus, an area, roughly bounded by the openings of the ureters and mesonephric (ejaculatory) ducts, is mesodermal. Besides the trigone of the bladder, the area includes a proximal segment of the urethra.

Johnson states that, in the male, the prostate originates as solid sprouts from the prostatic urethra, growing from the posterior, lateral and anterior walls, both below and above the entrance of the ducts. The tubules grow rapidly in length, soon acquire a lumen and begin to branch. The average number of tubules is

sixty-three, and they are divided into five groups. The formation of the lobes is not essential in this discussion save in recalling that Johnson has confirmed Lowsley's work in finding a distinct middle lobe which is formed from the posterior tubules. He could not find septa between the other lobes.

Richardson, in 1904, in his thesis on the prostate, concludes:

"The prostate glands are developed in the wall of the genito-urinary sinus, at a point farther from the bladder than the opening of the utricle. They are, apparently, mucous glands of the urogenital sinus, and they consist, in the fourth month, of a few branching columns of cells which cluster together at the back of the urethra where they are seen in two separate masses, one on each side of the middle line. In the ninth month they are large, more fully developed, and form visible projections; they are two separate and distinct glands, and have grown beyond the limits of the external wall of the urethra."

Lowsley, in addition, stresses the importance of the sub-cervical and sub-trigonal glands, which he claims are distinct from the prostate in structure.

Briefly, there are two fundamental views on the subject:

1. That prostatic tubules take origin proximal and distal to the verumontanum.

2. That prostatic tissue takes origin distal to the verumontanum, that is, only from the urogenital sinus.

If the first opinion is correct, we may assume that there exists in the true female urethra homologues of male structures that are proximal to the verumontanum; and that the structures in the anterior portion of the female urethra are homologous to those in the male distal to the verumontanum.

If the second opinion is correct, that prostatic tissue takes origin only from the urogenital sinus, we should not expect to find glandular structures in the true female urethra, only a homologous glandular rest in the anterior urethra and vestibule.

With this in mind, we may summarize the work that has been done pertaining to the female urethra.

Virchow, in 1853, Tourneux, in 1889, and Pallin, in 1901, concluded that prostatic tissue was present in the female urethra in varying amounts.

Evatt, in 1911, excluding the urogenital sinus in his study, concluded that the glands surrounding the whole length of the female urethra are the homologues of the prostate in the male.

Johnson reproduced the whole female urethra in wax from microscopic slides. He concluded that urethral glands, which are absent in a female embryo of 43 mm., are present in great numbers in an embryo of 60 mm. They are situated both along the true urethra and at the proximal end of the urogenital sinus. Contrary, however, to the arrangement found in the male, the majority of glands belong to the true urethra. The gland buds of a 60 mm. embryo are found on the anterior, lateral, and posterior surfaces of the urethra, and in this respect correspond exactly to the arrangement found in the male. Their structure is, likewise, similar to that of the male; they are rounded, solid, epithelial growths which extend into the surrounding mesenchyme, the majority being extended toward the bladder. At this stage of 60 mm., fourteen gland buds belong to the urethra and five to the urogenital sinus.

In the 176 mm. fetus, urethral glands are present all the way down the urethra to the orifice, and the few that are found outside the orifice originate from the urogenital sinus. Two of these, larger than the others, are placed on either side of the orifice. They divide into several branches and are lined with a stratified epithelium which, in places, assumes cuboidal characteristics. These glands conform in position to the para-urethral ducts of Skene's glands, and their origin as prostatic ducts, belonging to the urogenital sinus, cannot be doubted.

From this we conclude as did Johnson that:

1. The urethra of the female corresponds only to that portion of the urethra of the male which lies between the internal urethral orifice and the orifice of the prostatic utricle. The remainder of the male urethra is represented in the female by the most distal portion of the urethra and the vestibule.

2. The whole homologue of the prostate in the female consists of (a) the urethral glands which are the homologues of those prostatic glands in the male which lie above the orifice of the prostatic utricle (therefore, true urethral glands), and (b) Skene's ducts which are the homologues of the prostatic glands which lie below the orifice of the prostatic utricle (sinus glands).

3. Bartholin's and Cowper's glands are true homologues.

4. The homologues of the glands of Littré in the male are called "minor vestibular glands" in the female.

The present trend of investigations in male and female hormones, may or may not substantiate these embryologic data with physiologic evidence. Although Korenchensky has produced an hypertrophied "female prostate" in the female rat by the injection of the diol of androsterone, the obvious analogy is quite unclear.

REVIEW OF THE LITERATURE ON THE FEMALE URETHRA AND BLADDER NECK

Urethral pathology is comparatively limited in variety. The factor to be stressed, however, is the frequency with which it occurs. Because the clinical symptoms of urethral disease cannot be adequately differentiated from those of bladder lesions, special emphasis must be placed on a thorough examination of the entire urethra. Folsom stresses that the symptomatology of urethral pathology may be that of referred pain. We have found disease in symptomless cases.

Bugbee's statistics, which comprise 1000 cases of frequency of urination in women, show that lesions in the urethra were present in 690 instances (69 per cent).

In 1927, Stevens cited 234 consecutive female cases complaining of various urinary disturbances. The urethra was entirely responsible in fifty-six, and partly responsible in 173 instances.

In 1935, Stevens reported 425 female patients with urinary disturbances. The urethra was wholly responsible in sixty-seven cases and partly in 328.

In a series of eighty-six cases, Pugh found strictures in the following distribution:

External orifice	52 patients
Outer third	24 patients
Middle third	3 patients
Inner third	7 patients

Walther and Willoughby, in 1935, reported that in eight years they had seen thirty-five proliferating lesions of the urethra. They obtained the following biopsy specimens.

4 cases of carcinoma
2 cases precancerous
40 per cent malignant
4 papillomas
3 cysts
1 caruncle
1 prolapse of urethra
60 per cent benign

Counseller, Patterson, and Menville discussed carcinoma of the female urethra and the probable origin from the surrounding glandular structures.

In the gross study of the urethra, bladder neck and trigone, Renner stressed the presence of "hard black excrescences which look like nodules." He expressed the opinion that these "correspond entirely to the concretions met in the male bladder and sticking into the excretory ducts of the prostate," and that "under the trigonal portion one sees complex gland structures of acinous and tubular elements which give the impression of prostatic glands. The glands increase in size and extent, the closer they approach the posterior portion of the urethra. Both the superficial and deep portions of these complex gland structures have great resemblance to the male prostate, and in a certain way to Cowper's glands—especially to the gland content."

Folsom, from post-mortem studies, concluded that there exists a group of glandular structures surrounding the posterior part of the female urethra, not simple mucous crypts, but glands that extend into the muscular coat; and that some of them seemed to be of the branched tubular variety. He felt that such structures, though rudimentary by comparison, closely resemble the prostatic gland and seminal vesicles of the male. Folsom and his co-workers maintained that there exist sufficient gross pathologic lesions to produce not only a local irritation of the bladder, but also "to serve as an adequate irritating stimulus for referred pain."

CYSTIC DISEASE OF THE GENITO-URINARY TRACT

It is our belief that cystic disease has a direct bearing on the pathology of the female urethra. Ever since Morgagni, in 1761, called attention to cystic disease of the kidney pelvis and ureter, much has been written on this subject. Recent communications have thoroughly reviewed and discussed pyelitis cystica, ureteritis cystica and cystitis cystica. The clinical entity of the disease is fully appreciated.

Since von Limbeck, in 1887, and von Brunn, in 1893, called attention to the proliferation of the lining epithelium of the kidney pelvis, ureter and bladder in terms of cell nests and cell buds, the manner in which these cysts are formed has been more fully understood. It is not settled, however, whether the central portion of

these cell nests or buds degenerate or whether they begin to secrete and thus become cystic. We do not consider it necessary to discuss other theories of cyst formation.

The age incidence in which von Brunn's cell nests may occur is not an established fact. Jacobson was unable to find epithelial cell nests in any of the ten levels of each ureter taken from infants five days to eighteen months of age. Markwald, however, reported a case of ureteritis cystica and cystitis cystica in a new-born

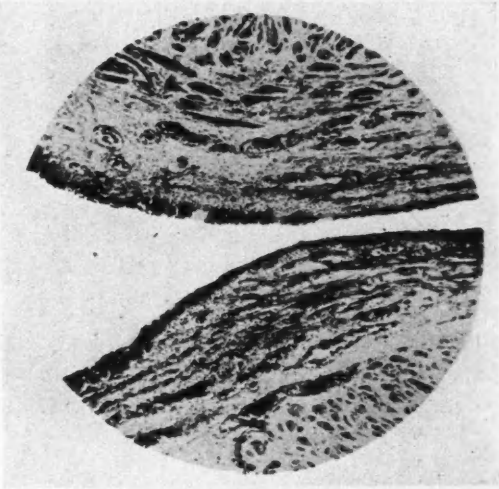

Fig. 2. Normal bladder neck and adjacent urethra in a five-weeks-old child. ×25.

child. Although Markwald and Aschoff assert that inflammation is not a prerequisite to the formation of nests and buds, we believe that more recent opinion favors the association of inflammation with epithelial cell nests and cystic disease.

PERSONAL WORK

Our work comprises the histopathologic study of the female bladder neck and urethra; and from the study of fifty post-mortem specimens we feel that a beginning has just been made. Our series includes thirty specimens from adults, forty years and older, seven-

Fig. 3. Normal urethra with extreme mucosal invaginations in a nineteen-months-old child. ×25.

Fig. 4. Two large lateral longitudinal folds in the urethra. ×25.

teen specimens from children, four years and younger, and three specimens from persons, ten, thirteen and twenty years of age respectively.

We believe that, in order to have a true perspective of the urethra and bladder neck, it is necessary to study those structures in the young child and compare them with those in the adult, for the following reasons:

1. Adult specimens differ greatly one from another.
2. Adult specimens reveal evidence of inflammation.
3. Child structures more closely approach the normal.

Our sections were cut longitudinally to include all the available urethra with as much of the trigone as possible. Five of our children's specimens were serially sectioned. The remaining specimens were sectioned at least every 100 microns.

We encountered two types of bladder neck and urethra.

Figure 2 pictures the smooth mucosa without any invaginations or perimucosal structures about the vesical orifice and adjacent urethra. This uninterrupted smooth mucosa extends to the anterior urethra.

Figure 3, which we consider a second type of normal urethra, is taken from the urethra adjacent to the vesical orifice. We have seen this type in three of seventeen children's specimens. This is the most extreme case of mucosal invagination encountered. The depth of the invagination is dependent upon the degree of relaxation of the structure. Serial sections show that these isolated peri-urethral structures are portions of simple invaginations. One can readily be misled by these.

There are in the urethra six mucosal folds; two on each lateral surface, and one each on the dorsal and ventral surface. When these are cut tangentially, isolated perimucosal structures add confusion to the interpretation. Figure 4 illustrates two large lateral folds.

In the anterior third of the urethra, and occasionally in the middle third, peri-urethral tubular structures distinct from Skene's glands are evident. They are seen to open into the floor of the urethra adjacent to Skene's ducts when they occur. They are found in only three of our seventeen children's specimens. Figure 5 pictures some seen in the region of the mid-urethra.

Fig. 5. Peri-urethral tubular structures in mid-portion of urethra of a nineteen-months-old child. ×45.

Fig. 6. Intra-epithelial gland and vacuole in a five-year-old child. ×350.

There are in the epithelial lining of the bladder neck, of the urethra, in the urethral crypts and invaginations, in Skene's glands and ducts, glandular cells, only a few of which secrete mucin as shown by the mucicarmen stain. We believe that the remainder secrete a different substance that does not stain differentially. The cells surrounding the small lumen have taken on a definite secretive appearance and are quite distinct from the surrounding transitional epithelial cells. The nucleus is placed in the central or basillar portion of the cuboidal type cell leaving an upper zone of light pink stained cytoplasm. They are small accumulations of glandular cells, which have a small lumen; they do not cause the epithelium to bulge into the canal, nor do they cause the basement membrane to project into the connective tissue. Maximow and Bloom describe these as a transitional step between the unicellular and multicellular glands, and call them intra-epithelial glands.

There is also present another type of intra-epithelial structure which we have described as a vacuole, some of which contain mucinous material. It is not lined by any highly specialized epithelium other than the regular transitional epithelium of the mucous membrane. The lumen is formed by pyknosis of the cells. Some of these vacuoles can be seen to open on the surface. However, most of the vacuoles have no opening to the surface. The distribution is comparatively constant; most frequent in the proximal and middle urethra, fewer in number about the bladder neck and distal urethra, and sometimes absent in Skene's ducts. A few of these vacuoles have been seen in the adult specimens. Figure 6 illustrates both the intra-epithelial gland and the vacuole.

Our study of children's specimens, which we consider "normal," resulted in the following conclusions:

1. Ridges, folds and invaginations are deceptive in a relaxed mucosa, and may be mistaken for gland structures.

2. True peri-urethral glands do not exist in the one-third of the urethra that is adjacent to the bladder.

3. Evidence of a homologue of the sub-cervical or sub-trigonal glands, described by Lowsley in the male, was not found in the specimens studied by us.

4. Simple peri-urethral tubular epithelial structures appear in the anterior two-thirds of the urethra adjacent to the compound

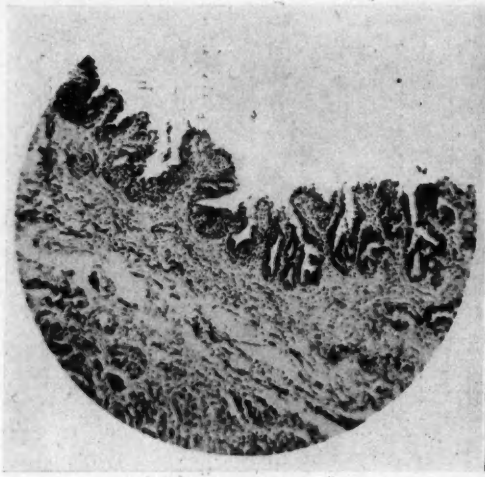

Fig. 7. Subepithelial proliferation of connective tissues causing irregularity of mucosa at bladder neck in an adult. ×25.

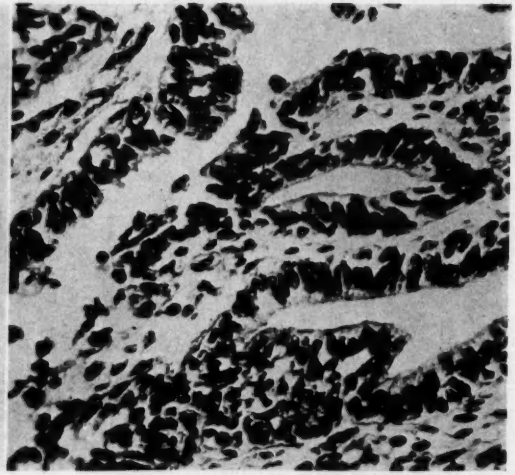

Fig. 8. The cells at the base of the folds have the nuclei centrally or basillary placed. ×400.

racemose glands of Skene. (As far as we can tell, these are distinct from Skene's ducts and are not a constant finding. They are much less frequent in the middle third than in the anterior third of the urethra.)

5. Skene's glands are always present as para-urethral glands, which though they may encircle the entire anterior urethra, drain nevertheless through their openings on the floor.

6. Glandular structures are found within the mucosal epithelial lining of the bladder neck, of the urethra, and of Skene's ducts. These are called intra-epithelial glands.

7. Vacuoles are present in the mucosal lining. These may be the forerunners of the epithelial gland. They are formed about pyknotic cells.

Twenty-eight of our thirty adult specimens over forty years of age showed a round-cell infiltration. In addition twenty-four of these cases showed evidence of connective tissue proliferation. Sixteen cases had epithelial cell buds or nests, either in the posterior urethra or bladder neck, or both. Eleven cases had cysts over the same distribution.

Each of the patients, ten, thirteen, and seventeen years of age respectively, had round-cell infiltration.

Four of our seventeen cases of children four years and younger, had a round-cell infiltration. Three of these had epithelial cell nests.

Figure 7 is one of many specimens of fronds or papillæ found in the posterior urethra and bladder neck. We interpret this to be the scarring of a previous inflammatory process with a proliferation of the sub-epithelial connective tissue.

Under high magnification, Figure 8 is taken from the base of the crypts shown in Figure 7. The lining epithelium in this portion differs from that seen on the upper portion of the fronds. The nuclei of the cells are more deeply placed and there is an outer zone of clear cytoplasm. This type of lining epithelium is frequently seen in the glandular structures of the anterior urethra. Embryologically this tissue in the posterior urethra and trigone has the same origin as some of those glands in the anterior urethra. We thus assume that under the proper environment or stimulation both have the same inherent properties.

Fig. 9. Round cells, proliferation of lining epithelium and intra-epithelium vacuoles. Child four years old. ×45.

Fig. 10. Enlarged intra-epithelial structure. Seven-months-old child. ×60.

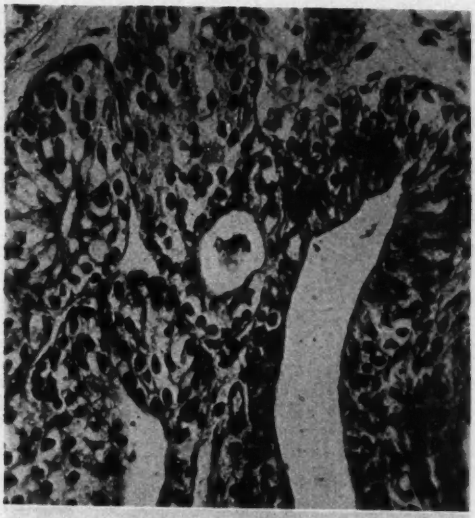

Fig. 12. The intra-epithelial structure of Figure 11. ×350.

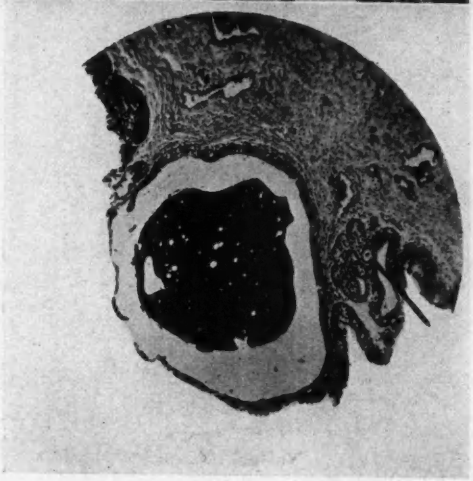

Fig. 11. Superficial cyst at urethro-vesical junction with adjacent intra-epithelial vacuole. ×45.

Fig. 13. Multiple cysts at urethro-vesical neck. ×25.

Fig. 14. Subepithelial structures in mid-urethra. ×70.

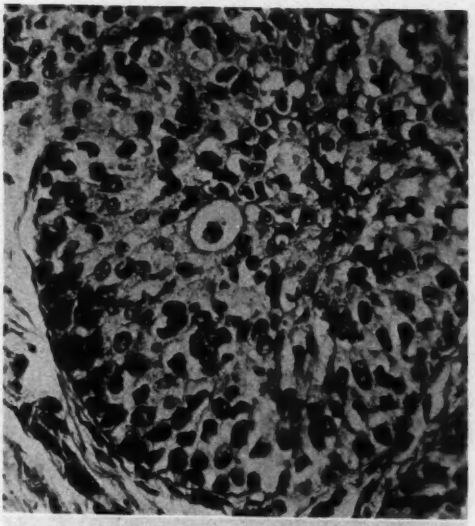

Fig. 16. The subepithelial cell nest of Figure 15 illustrating vacuole and pyknosis. ×400.

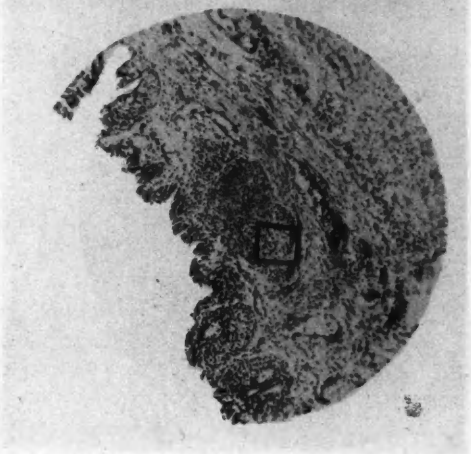

Fig. 15. Isolated sub-epithelial cell nest. ×45.

Fig. 17. The intra-epithelial structures increase in size. ×45.

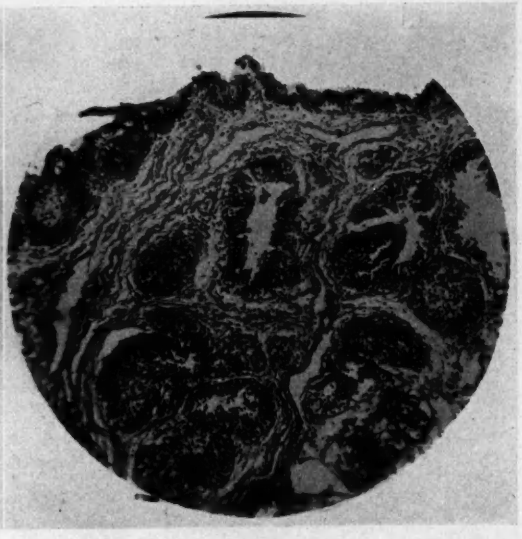

Fig. 18. Epithelial cell nests deeply embedded at urethro-vesical junction. ×60.

At the vesical neck of the four-year-old child, in Figure 9, is seen:

1. A round cell infiltration surrounding a proliferation of epithelial cells or von Brunn cell bud.
2. In the opposite mucosal surface intra-epithelial vacuoles.

Figure 10 illustrates an urethral intra-epithelial structure increasing in size.

Figure 11 is a superficial cyst encountered at the urethro-vesical junction of a forty-seven-year-old woman. This probably took origin from a similar intra-epithelial structure that is seen adjacent to it, which Figure 12 shows under higher magnification.

A later stage of those small cystic and glandular-like structures seen in the earlier figures is seen in Figure 13. The fact that these cysts rupture spontaneously is the reason why these women have transitory symptoms. The passing of the cystoscope is sufficient instrumentation at times to break these structures and give the patient temporary relief. The latter may also be said of Figure 14.

This sub-epithelial cystic structure has taken origin from an epithelial cell nest and is found in the mid portion of a urethra. Similar structures have been found through various portions of the entire urethra.

Figure 15 shows two isolated epithelial cell nests beneath the mucosa of the urethro-vesical junction. These nests under a higher magnification in Figure 16, show an intra-epithelial structure similar to those seen in the urethral mucosa. This small lumen is the precursor of larger cystic structures as seen in Figure 17.

The more long standing the inflammatory process in the submucosa, the greater is the production of submucosal fibrous tissue and the greater is the depth to which these epithelial cell nests are pushed beneath the surface. Figure 18 illustrates this point.

We have mentioned that the intra-epithelial substance may be mucin or another colloid. We have also seen laminated concretions in Skene's glands, in the subepithelial structures along the urethra, at the bladder neck, and in Gartner's ducts. Figure 19 illustrates four such structures at the urethro-vesical junction.

Figure 20 is a higher magnification of one of these cystic structures with laminated enclosures.

In Figures 7 and 8 we have called attention to a frequent frond-

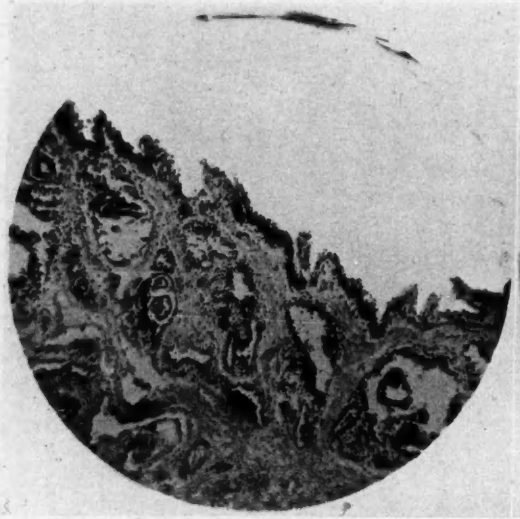

Fig. 19. Multiple laminated enclosures in subepithelial structures in urethra adjacent to bladder. ×45.

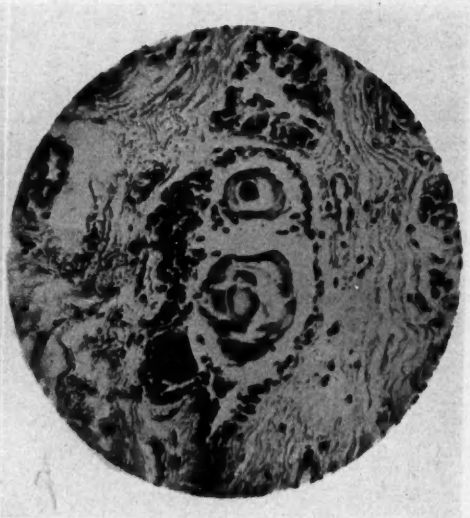

Fig. 20. Laminated structure of Figure 19. ×200.

like structure, and have mentioned that the base is lined by a cylindrical type of cell. Patch and Rhea have shown that these cells secrete mucus. This type of epithelium which is a transformation from the transitional epithelium is a metaplasia. A second type of metaplasia is a transformation to the squamous epithelium.

The stimulus for this metaplasia is inflammation and irritation. We have encountered two cases in which the stratified squamous epithelium lined the entire urethra and bladder neck. In a third case the bladder neck and adjacent one-third of the urethra was lined with squamous epithelium.

DISCUSSION

One might rightfully ask if 95 per cent is not an unusually high rate of infection in the urethra and bladder neck. And is the observed cellular infiltration a terminal event? To this inquiry we can only emphasize the fact that 85 per cent of our adults had additional evidence of inflammation that could not be a terminal affair. However, this does not rule out the fact that this inflammatory process is not secondary to some of the long standing terminal illnesses as chronic osteomyelitis, brain tumor, and heart disease.

Certainly in two instances mechanical factors may be partly responsible. One patient required catheterization for ten days before succumbing to her illness, and the second patient succumbed from puerperal sepsis following childbirth.

On the other hand we can turn to our children's specimens. Discounting our six cases of still born, we have remaining seven patients that have succumbed to pneumonia, osteomyelitis or empyema, that do not have any round-cell infiltration. Two of the four remaining patients with round-cell infiltration succumbed to pneumonia, and the third patient had osteomyelitis. Because of these seven cases, we feel that the terminal illness is not entirely responsible for our high percentage of round-cell infiltration.

We have called attention to two distinct types of metaplasia of lining epithelium in the urethra and bladder neck. It might rightfully be supposed from the above observations that primary carcinoma of the urethral mucosa *per se,* should not be too infrequent. But this is not so; for in nineteen years with approximately 5,000 admissions, only two cases were diagnosed as carcinoma of the

Fig. 21. Squamous epithelium found in the entire urethra and vesical neck.

Fig. 22. The solitary cyst and one of the many lymph follicles.

urethra. At present we are not certain, in these two cases, that the growth did not take origin from peri-urethral structures. We have seen many cases, however, with primary malignancy either in the rectum or cervix with extension to the peri-urethral structures.

Two cases not included in our series, are of distinct interest.

A child nineteen months of age had the following post-mortem diagnosis:

1. Bilateral chronic pyelonephritis.
2. Slight right hydro-ureter.
3. Bilateral kinking at the uretero-pelvic junction.
4. Patchy atelectasis of lungs.
5. Patchy lipoid and chronic interstitial pneumonia.

Serial sections made from the urethra and vesical neck revealed this solitary cyst at the vesical neck, accompanied by lymph follicles. The multiple lymph follicles resemble that condition summarized by Kretschmer in 1908, which he classified as cystitis follicularis and pseudo-follicularis.

An extension of this follicular process is seen in the entire urethra. We have called this urethritis follicularis.

The second non-tabulated case is that of a nine-year-old-child who succumbed with tubercular meningitis, and miliary tuberculosis. The post-mortem examination revealed in addition tubercles in the kidneys, bilaterally.

Histologically, we encountered this solitary tubercle in our serial section from the vesical neck. It is entirely subepithelial without any ulceration of the surface epithelium. In this instance the origin is from the blood stream infection. There is also a very early proliferation of the subepithelial connective tissue, and the early formation of a frond secondary to the inflammatory process.

CONCLUSIONS

From a comparison of the thirty adult specimens of the female urethra and bladder neck, with seventeen similar specimens in children four years of age and younger, we conclude that:

1. Chronic inflammation of the urethra and bladder neck is present in a higher percentage of adults than we have heretofore imagined.

Fig. 23. One of the follicles seen in the urethra.

Fig. 24. The solitary subepithelial tubercle.

2. Perimucosal structures about the bladder neck and posterior third of the urethra are acquired.

3. These acquired structures simulate prostatic tissue because they take origin from the same type of embryologic tissue, and thus have the same inherent properties.

4. The stimulus required for the acquisition of these structures may be:

(a) Infection within the genito-urinary tract.

(b) Structural anomalies within the genito-urinary tract.

(c) Trauma of childbirth.

5. These buds and nests known as von Brunn cell nests or buds, in so far as they are a proliferation of the mucosal epithelium, develop their lumen from the intra-epithelial glands as seen in the mucosal epithelium in children.

6. Those structures about the bladder neck and posterior urethra referred to by previous workers as prostatic structures, we consider to result from a process similar to cystic disease of the upper genito-urinary tract, better known as pyelitis cystica, ureteritis cystica, and cystitis cystica, according to location. We propose to call it cystitis cystica about the bladder neck, and urethritis cystica when it occurs in the urethra.

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COMMENTS ON BLADDER CARCINOMA

CLASSIFICATION—PROGNOSIS—TREATMENT

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This paper is very frankly presented for the purpose of stimulating a discussion which I know would be instructive and illuminating to me and I am reasonably sure would be interesting to every member of this society. I have been provoked into presenting my paper at this time by two very definite factors:

1. The very wide discrepancy in results reported from various clinics, particularly in relation to the percentage of so-called five-year cures, ranging from 10 per cent to 45 per cent.

2. The very wide variety of views expressed in published articles and in personal conversations by different surgeons as to the most desirable method of handling these cases, not alone as a group but in isolated individual cases.

My own views, for what they are worth, have been formed in part from an effort to digest the varying opinions of others but in large measure from a recent review of my own cases made by one of my associates, Dr. Frederick T. Bond, and published in the March number of *The Journal of Urology*.† While our group is small compared to those reported from larger clinics, they were rather carefully studied and the follow-up was over 90 per cent complete, so that we felt warranted in reporting them.

These cases covered a fourteen year period from 1918 to 1933, excluding 1919, when for some reason or other the records were not available. There were ninety-one cases of bladder carcinoma. In twenty-eight of these, for a variety of reasons, histologic data were not available. With practically no exceptions these patients went on and died from obvious carcinoma, so our clinical diagnosis would appear to have been correct. However, lacking the histologic data they were excluded from special study. This leaves only sixty-three proven cases. They were subjected to a wide variety of treatment, which I shall not discuss here. The histologic classifi-

†The reader is referred to this article for details of the report.

cation was epidermoid carcinoma 45 per cent, papillary carcinoma 29 per cent, adeno-carcinoma 16 per cent, scirrhous, medullary and undetermined types 10 per cent.

Our results have been far from encouraging. Fifteen patients were alive and, with one exception, free from any signs or symptoms of recurrence at the end of three years. However, in the next two years eight of these patients had recurrences and died, which left us a five-year salvage of only seven cases (11 per cent). One of these patients should perhaps be excluded. She lived for nine years after her first operation but beginning at three years she had repeated recurrences of papillary tumors diagnosed in our laboratory as papillary carcinoma; in the registry, papillary carcinoma Grade I +. She died eventually from renal sepsis and insufficiency, with her latest recurrence still growing in her bladder. I think quite a few cases terminate by this route. Of the remainder two patients were alive and well at eleven years. A recent follow-up on one of these cases reports that two years later (thirteen years after operation) the patient was operated upon in another clinic for carcinoma of the bladder and died from uremia. Our original diagnosis was epidermoid carcinoma, which was also the diagnosis at the other clinic. He was not recorded in the registry as our original slides were lost. One patient died at ten years from a carbuncle with no evidence of recurrence, one is alive and well at eight years, one at seven years and one at five years. The registry diagnosis in four cases was epidermoid carcinoma Grade III, one case papillary carcinoma Grade III.

As to the diversity of published results, these vary, I repeat, from results no better than my own to as high as 45 per cent of control. This is confusing and perhaps misleading. These reports have all been made by distinguished urologists whose veracity and integrity are beyond reproach. Undoubtedly better judgment and greater skill may account for some of this discrepancy but there must be other factors. I think there are two: First, some of the reports are based on a three-year salvage. This, I believe, is wrong. I am sure there is a heavy mortality between the three and the five-year period. Second (and this is far more important): I believe that considerable confusion exists as to what constitutes carcinomas of the bladder and how they should be graded in relation to their malignancy. The Broders grading seems to have been

more or less universally adopted and has undoubtedly served a purpose. On the other hand, it is far from perfect and has, I think, led to some confusion. As I understand it, Grade I constitutes in the vast majority of cases what most of us understand as simple papillomata, which are of course readily and easily controlled. It hardly seems fair to include them in the same category with bladder carcinoma. Going a bit farther, it does not seem fair to include in the same grouping the papillary carcinomas, some of them pedunculated, with no infiltration of the bladder wall, and the hard infiltrating epidermoid carcinoma, except for the fact that they both have a tendency to recur (so has papilloma for that matter). They appeal to me as two entirely different diseases and I believe should be considered as such in any grading or any statistical review. I shall not dilate further upon this part of my paper but I sincerely hope it will be amply covered in the discussion.

TREATMENT

Basing this statement on published reports and informal personal communications, the treatment varies from the exclusive use of some form of radiation therapy with only incidental surgery as advocated by one group of able urologists to the other extreme of other groups who never employ radium and who have "never seen a case controlled by its use." Obviously both of these groups cannot be entirely correct. I believe there is a growing trend to individualize the cases and to avoid any preconceived notions in the conduct of any particular case. There are, of course, a wide variety of measures available. It is an unfortunate fact for the time being that any or all of those fail in the majority of cases to accomplish their entire purpose. However, it is also a fact that some or several of these various measures do in a number of cases provide a certain degree of amelioration and prolongation of life and in a pitiably small group of true cancers apparently bring about complete control. It would seem like common sense to approach each case as an individual problem and apply any method or combination of methods which appear best adapted for the case in question. Certainly that is my own personal attitude.

I believe that, when practicable, all bladder cancers should be radically excised. This would appear like a simple position to take if it were not for the fact that, because of their usual location, only

a small percentage of cases (20 to 25 per cent) lend themselves to this type of treatment. The fact that the growth invades one ureter orifice should not militate against such a procedure. I am convinced that the ureter can be transplanted to another part of the bladder with every expectation of conserving the integrity of the corresponding kidney. (I have one case, not cancer, in which both ureters were transplanted nearly ten years ago. The patient is in excellent health, with perfectly normal kidney function.) However, this is not the catch. The majority of cases in my experience invade the trigone in the neighborhood of the internal meatus to a degree that no excision short of total cystectomy could be considered a radical excision. For the great majority of cases, then, some other type of treatment must be elected and in the light of our present knowledge I believe that interstitial radiation offers us the best prospects in what at the best is a somewhat gloomy outlook.

In all cases, of course, one should determine by means of careful preliminary survey, including cystoscopy, cystography, et cetera, upon a tentative course of procedure and be prepared accordingly. However, it occasionally happens, in my practice at least, that the operative findings do not check exactly with the cystoscopic expectations and for that reason I believe the bladder should be exposed and opened in the simplest possible manner and the final course of procedure definitely decided upon after a careful investigation of the pathologic changes present. One exception to this policy is in the cases where there is an obvious and extensive invasion of the anterior wall. These cases should be approached from the rear. If a radical excision is decided upon, complete mobilization of the entire bladder is clearly essential. If on the other hand we plan to limit our efforts to the application of diathermy or radium or both, mobilization or any form of unnecessary handling should, in my opinion, be scrupulously avoided.

A considerable number of the semi-pedunculated, so-called Grade II, papillary carcinomata are, I think, controlled by simple diathermy loop excision and thorough diathermy to the base. However, in this paper I am considering more particularly the infiltrating epidermoid type of growth, and diathermy has, I think, very little place in this group.

I shall not discuss the detail of methods of radium application.

Barringer and his group at The Memorial Hospital in New York have done a great service for urology in blazing the trail and teaching us the dosage and method of application. I have no doubt that most of us are employing too small doses. Some of us have had some radium burns and are treading perhaps a bit too lightly.

There are three other phases of the treatment of bladder carcinoma which I should like to present very briefly.

1. *Cystoscopic Treatment.*—In this present wave of enthusiasm over transurethral surgery there is, I think, quite a trend toward the employment of this approach on these cases. I believe this may easily be overdone. Personally, I have reserved this approach for very small growths, particularly small recurrences. I am not including the fulguration of benign papillomas. In my hands, the application of more than four radium seeds through the cystoscope has been rather unsatisfactory. For one reason and another, bleeding, et cetera, I find it difficult or impossible to implant them with any degree of accuracy.

2. *Total Cystectomy.*—Inasmuch as carcinoma remains confined to the bladder, with no disposition to extend by metastases or otherwise for a considerable period of time, this would seem on the face of it the ideal treatment. Perhaps in the long run this may be the final answer. The operation *per se* is not technically difficult but there are two rather formidable obstacles to overcome. First, the disposition of the ureters. Transplantation to the bowel in this group of cases, even in the most skilful hands, carries with it a mortality which is almost prohibitive; transplantation to the groin, a bilateral nephrostomy, leaves a state of affairs which is far from ideal. This leads us to the second obstacle, which is the selection of cases. The very late cases are hardly ideal in spite of the fact that most total cystectomies are drawn from this group. Some of the not-so-late cases might seem to be eminently suited for this operation if it were not for one very important item; there is no question but that some of them are entirely and completely controlled by radium and one certainly hesitates to condemn any human being to a total cystectomy with all of its implications if there is even a remote chance of saving his bladder. I am sure that any one of us would find it a very difficult decision to make if his own bladder were at stake.

3. *X-ray Treatment.*—This method of attack is still in its infancy. Pfahler, of Philadelphia, has reported some remarkable results but his reports are sadly lacking in histologic data and lose much of their weight accordingly. However, it is being demonstrated that with modern technic effective radiation can be delivered to the desired spot. The modern x-ray is a very powerful agent and has potentialities for evil as well as good, evidenced by the fact that within the past year one of my patients died directly from its effect and another presented alarming symptoms for several weeks. It remains for the future to determine its place in our armamentarium.

In conclusion I would say that I realize I have dealt very tersely, perhaps lightly, with important matters. I realize, too, that I have made some rather broad statements with perhaps insufficient data to support them. However, I have attempted to present briefly my own views for what they are worth and largely for the avowed purpose of provoking a discussion.

BRAIN METASTASIS IN CARCINOMA OF THE BLADDER

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From the Brady Urological Institute, Johns Hopkins Hospital, Baltimore, Maryland

While the occurrence of metastasis in infiltrating bladder tumors has, of course, been well recognized, its rôle in the progress of the disease has been rather under-emphasized, on account of the recognized fact that, in most cases, it occurs late, and that in a high percentage of cases death occurs from obstruction of the lower ureters with resultant renal damage, usually associated with infection, before metastasis has occurred. The best recent available statistics (Cunningham, Spooner) indicate that metastasis is present in at least 30 per cent of cases of bladder tumors studied at the autopsy table. A recent analysis of ninety-eight cases of infiltrating tumors of the bladder, of which autopsy records are available at the Johns Hopkins Hospital, shows a percentage of 58 with demonstrable metastasis. In the majority of these cases, however, the cause of death was obstructive disease of the upper urinary tract, with infection and uremia, and the picture of general carcinomatosis, with clinical malignant cachexia, which we are accustomed to associate with the terminal phases of malignant disease of other organs than the bladder, was conspicuously absent. In the series studied, the cause of death could be attributed to general carcinomatosis only in three or four instances. A recent case, in which death occurred from brain metastasis, presented certain other interesting features which we consider of sufficient importance to record, and aroused our interest to make a study of the incidence of brain metastasis in tumors of the bladder.

A. C. S., civil engineer, aged forty-seven years, was seen on April 26, 1935. Frequency, nocturia, dysuria and hematuria had gradually appeared, beginning eight months previously. Rather severe pain had been felt for the past few months, radiating down the posterior aspect of the right thigh and leg. The patient had had frequent headaches for many years. Physical examination was essentially negative; no evidence of metastasis was demonstrable. On rectal examination there was slight induration noted at the base of the prostate and

definite thickening of the posterior bladder wall on the right side. The plain x-ray showed the outline of the left kidney slightly enlarged. An intravenous urogram (Fig. 1) showed the left kidney well visualized, slightly larger than normal. The pelvis and ureter were normal. No

Fig. 1. Intravenous urogram. There is an excellent excretion of the dye in the left kidney. The kidney is somewhat larger than normal. Pelvis, calices and upper ureter and lower ureter are well visualized and normal. The bladder shows a marked, irregular filling defect, evidently an extensive infiltrating carcinoma occupying the entire right side of the bladder and extending over the trigone.

dye appeared through the right kidney. The cystogram showed a large, irregular filling defect comprising practically the entire right half of the bladder. On cystoscopic examination the right side of the bladder was occupied by an extensive, irregular, nodular tumor, which

extended up to the vesical orifice, to the midline anteriorly, and down over the right half of the trigone, obscuring the ureteral orifice. The growth was nodular, non-papillary, with a great deal of superficial ulceration and necrosis, and was evidently deeply infiltrating. The left half of the bladder and the left ureteral orifice were normal in appearance. Radium treatment, consisting of 600 milligram hours by surface application, was given, and at the same time a course of deep x-ray, by the Coutard technic, was given under the direction of Dr. Charles A. Waters. There was an immediate response to treatment. The pain in the right hip and leg, which had been extremely distressing, disappeared during the first week; the frequency, nocturia and burning gradually disappeared during the course of the treatment, and the patient gained considerable weight.

Rectal examination, carried out on June 10, 1935, showed that the induration in the region of the base of the prostate and over the right half of the base of the bladder had almost entirely disappeared. Cystoscopic examination at this time showed a remarkable change. The bladder capacity was 400 c.c. The tumor had entirely disappeared except for a small, projecting mass of apparently viable tissue in the region of the right ureteral orifice. A large area of slough was present over the right half of the bladder wall, and the adjacent mucosa was reddened and edematous. The remaining portion of tumor tissue was destroyed cystoscopically by means of the high frequency current.

He returned to the hospital on July 30, 1935, stating that weakness and unsteadiness of the right leg had been present for the past two weeks. For the past ten days he had experienced severe headaches, with spots before the eyes, and two days previously vomiting began, accompanied by drowsiness. There were no urinary symptoms. The findings on physical examination were: optic discs entirely obliterated, poorly sustained ankle clonus on both sides, better on the right, and a positive Babinski reaction present on the right. There was, also, noticeable weakness of the right arm and leg. The blood urea and phenolsulphonephthalein tests were normal. X-rays of the chest, pelvis and skull showed no evidence of metastasis. There was a temporary symptomatic improvement, but two weeks after admission a rather sudden exacerbation of all symptoms occurred and the patient became semi-comatose. On August 25, 1935, a left craniotomy was done, both ventricles tapped, and a bony defect left for decompression. Four days later a resection of the left frontal lobe was done by Dr. Dandy, and a circumscribed tumor removed from the region of the third ventricle, attached to the septum pellucidum. The tumor looked perfectly encapsulated, and on section one could not be sure that it was a metastatic tumor. The patient did not survive the operation.

Surgical Pathologic Report: The specimen was a small piece of coarse, friable tissue, yellowish-gray and fairly firm. On microscopic section (Fig. 2) the tumor was made up of fairly small epithelial cells which were closely arranged in small cords and clumps, surrounded by

abundant, dense, fibrous stroma. The epithelial cells varied considerably (Fig. 3), but, for the most part, were fairly small, with indistinctly outlined cytoplasm and hyperchromatic nuclei. Mitotic figures were numerous. There were numerous vacuolated cells and an occasional giant cell was seen. This was obviously not a brain tumor. It would be impossible from the section to say from what tissue it originated, but it did suggest most strongly a carcinoma arising from transitional epithelium.

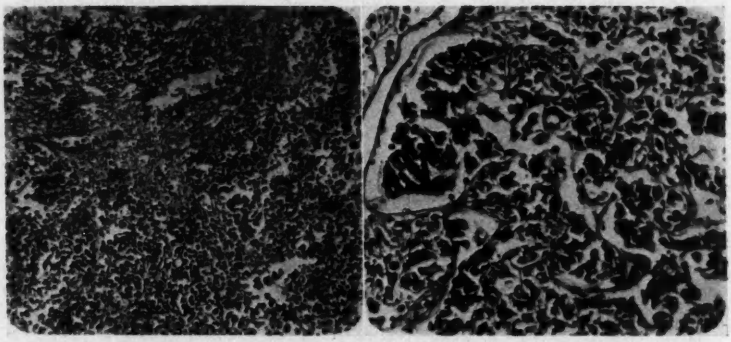

Fig. 2 *(left)*. Metastatic cerebral tumor removed at operation. Low power. Transitional cell carcinoma of extreme malignancy. The tumor cells are seen invading the loose brain tissue. The tumor shows no characteristic architecture, with a very small amount of stroma.

Fig. 3 *(right)*. Metastatic cerebral tumor removed at operation. High power. The characteristic transitional epithelial cells are well seen, with little supporting stroma.

Postmortem Examination: No evidence of tumor was found except in the brain and urogenital tract, and there were no other important lesions. The left kidney was slightly larger than normal, with smooth surface, and was normal in appearance on section. The pelvis and ureter were slightly dilated. The right kidney was very much smaller than normal. It was distinctly shrunken, with thinned out cortex, but the external surface remained relatively smooth. On section there was a moderate hydronephrosis and hydroureter, the diameter of the ureter increasing as one approached the bladder. The ureteral wall, at its entrance into the bladder, was stiff and thick, but the lumen would still admit a small probe with difficulty. When the bladder was opened (Fig. 4), no gross evidence of tumor was seen. There were two dense scars involving the right half of the bladder wall, the right side of the trigone and the ureteral orifice. Most of the scarred areas were covered by epithelium, but two small areas of superficial ulceration were seen. The bladder wall in this region was thickened and stiff, but there

was no definite gross tumor. Examination of the brain showed operative absence of the left frontal lobe. A tumor nodule, 2.5 x 1.5 cm., was found attached to the falx on the left side. On section the nodule was found to be firm, without any definite structure, and along one margin appeared to invade the dura. On section of the brain the site

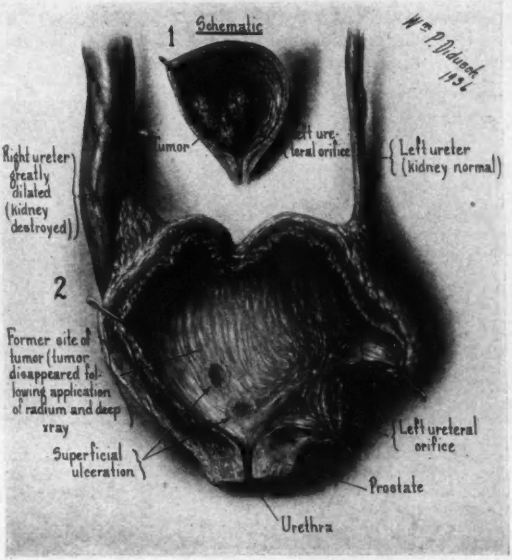

Fig. 4. A. C. S. Author's case. (1) Schematic representation of extent and location of tumor as determined at first cystoscopic examination. (2) Autopsy specimen. In gross the tumor has been completely destroyed. Two small areas of superficial ulceration are seen at its former site. The right side of the trigone is flattened and the orifice completely obliterated. The right ureter is enormously dilated. The left ureter is normal.

of the tumor nodule enucleated from the left corpus striatum just external to the third ventricle was found. On further sections no other tumor nodules were demonstrable.

Microscopic Studies: The original sections made from the scarred areas in the bladder failed to reveal any tumor. Serial sections of one scar were then made, several passing through the tiny ulcerations observed in the gross specimen. These sections (Fig. 5) revealed a few

clumps of tumor cells lying on the surface, and several somewhat larger clumps of cells were found deep down in the bladder wall (Fig. 6), entirely separate from the superficial tumor. The character of the tumor could not be accurately determined from these few clumps of cells, but it suggested a transitional type of tumor of grade IV malignancy. Some of the sections included the ureter, which was reduced to a mere slit by the surrounding dense scar tissue (Fig. 7). Section of the brain metastasis (Fig. 8) showed that the tumor consisted of small epithelial cells which were arranged in such a fashion as to suggest a cancer of transitional cell origin (Fig. 9).

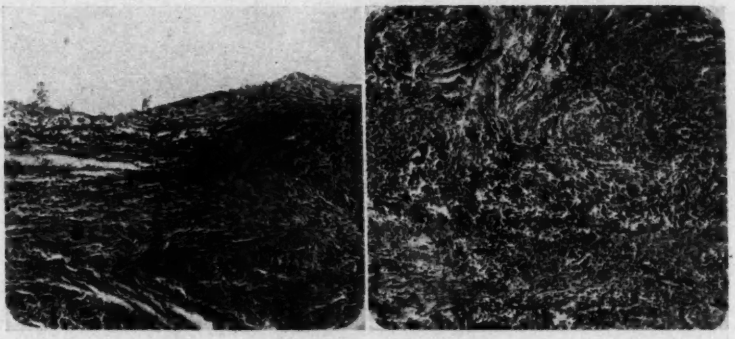

Fig. 5 *(left)*. Section through superficial ulceration of bladder mucosa. There is an absence of normal bladder mucosa. Close to the surface can be seen an irregular area of infiltrating cancer cells with no particular structure. There is marked fibrosis of the bladder wall.

Fig. 6 *(right)*. Section taken at a deeper level in bladder wall beneath the scar. Irregular infiltration of tumor cells without any characteristic architecture can be seen. Fibrosis and scar tissue formation is marked.

A survey of the literature has confirmed our belief in the rarity of cerebral metastasis from bladder tumors. Our conclusions are based on Spooner's analysis of 132 autopsies of bladder tumors at the Mayo Clinic; a report of fifteen autopsy cases by Barringer, twenty-five by Cunningham, and Geraghty's series of 219 cases; in addition, G. G. Smith and E. R. Mintz's study of 150 cases of bladder tumor, thirty-seven of which came to autopsy, and finally, the study of 902 epithelial tumors of the bladder in the Carcinoma Registry of the American Urological Association, seventy-nine of which came to autopsy. We have, therefore, a series of 625 autopsies on patients dying of carcinoma of the bladder. In addition, we have studied the various clinical and autopsy statistics available in

cases of metastatic brain tumor. These studies consist in the series of Gallavardin and Varay, four cases; Grant, Peter Bent Brigham series, forty-three cases; Humbert and Alexeiff, thirteen cases; Spiller and Weisenberg, eleven cases; Globus and Selinsky, twelve cases; Dunlap, Mayo Clinic, ninety-five cases; Meagher and Eisenhardt, forty-four cases, in addition to the metastatic brain tumors in the Johns Hopkins Hospital and the Cushing Tumor Registry at New Haven. Although the total number of metastatic tumors in

Fig. 7. Section through the bladder wall, including the ureter. No evidence of tumor cells can be seen. There is marked fibrosis and scar tissue formation, and the ureter is evidently compressed.

the compilation is well over 300, only two cases of metastasis from the bladder were found, that of Globus and Selinsky, and Lower's case of bladder tumor. The patient in Lower's case was operated on by Dandy for metastatic tumor of the brain at the Johns Hopkins Hospital.

In our series of 625 autopsy cases of patients dying of tumor of the bladder, we found only two cases with brain metastasis, an incidence of only 0.3 per cent, while the incidence of metastasis in general was greater than 30 per cent. It, of course, should be emphasized that these figures must be too low, inasmuch as examination of the brain was not made in all of the autopsy cases, probably only in those which gave evidence before death of a cerebral disturb-

ance, and, of course, serial sections would have to be done to rule out the possibility of small cancer nodules which might well be overlooked in the gross. Even so, brain metastasis must be exceedingly uncommon, and in over 800 clinical cases of bladder tumor in the records of the Brady Urological Institute, brain metastasis has been encountered clinically in only two instances.

We have been able, then, to find only seven autopsy cases of carcinoma of the bladder with brain metastasis. Of these, five cases

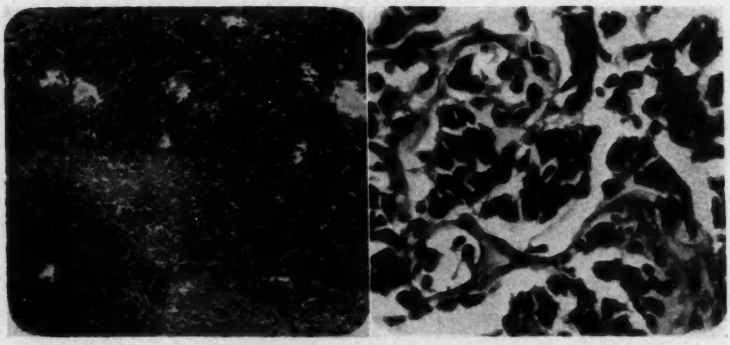

Fig. 8 *(left)*. Autopsy specimen of cerebral metastatic nodule. Low power. The tumor cells can be seen infiltrating the loose brain tissue, with some stroma.
Fig. 9 *(right)*. Autopsy specimen of cerebral metastatic nodule. High Power. Typical tumor cells originating from transitional epithelioma are seen infiltrating the brain tissue with no characteristic structure.

(Lower, McKay, Kretschmer, Beatty and Colston) are complete, there being available microscopic sections and, in some instances, gross specimens of the primary and metastatic growths. We feel that these cases are of sufficient interest to present a synopsis of the clinical and pathologic studies.

Case 1 (Buday).—The author reports one case of cerebral metastasis found in autopsy studies on eighteen cases of bladder tumors. There is no note as to the microscopic nature of the tumor, its extent and infiltration in the bladder, or whether other metastases were present.

Case 2 (previously reported by Lower and Watkins).—An engineer, aged forty-six years, had terminal hematuria and burning on urination for five years. On cystoscopy a round, fungating tumor was found. On suprapubic cystotomy by Dr. Lower, the tumor was excised and

400 milligram hours of radium applied at the base. Three weeks before operation there had been noted difficulty in speech. Five days after operation weakness of the right arm developed, soon followed by severe headache. A month later the symptoms were so well localized as to permit a tentative diagnosis of tumor in the left fronto-parietal region, presumably metastatic from the bladder. At operation on June 6, 1922, a single, circumscribed tumor was removed from the left internal capsule by Dr. Dandy. Cystoscopic examination two months later by Dr. Geraghty showed a normal bladder with a smooth scar, and no evidence of recurrence. The surgical pathologic diagnosis was brain tumor, metastatic, transitional cell epithelioma, probably from the urinary bladder. The patient died ten months later from a clinical recurrence of the brain metastasis.

Case 3 (Globus and Selinsky).—The patient had cerebral symptoms of three months' duration and terminal psychosis. Death occurred without operation. At autopsy multiple, metastatic, carcinomatous nodules were found in the cerebrum and cerebellum. Microscopically the cells were squamous and arranged in reticular or syncytial character, originating from a tumor of the bladder. No sections from the original tumor were studied. There was no note as to whether other metastases were present.

Case 4 (McKay).—The patient was a man, aged fifty years, with hematuria of five days' duration. On cystoscopy a flat, sessile tumor was seen, obscuring the region of the right ureteral orifice and extending to and apparently involving the vesical orifice. On rectal examination definite thickening was felt on the right side of the posterior bladder wall. The tumor was destroyed by fulguration, and surface applications of radium, 2,100 milligram hours, together with two full courses of deep x-ray therapy were given. Ten months after the first examination the patient developed a left epididymitis after one of the many cystoscopic treatments. During his confinement he developed acute frontal headaches, later followed by projectile vomiting and the typical symptoms of a brain lesion. He died twenty-one months after the first examination. Postmortem examination showed an epidermoid carcinoma of the bladder mucosa, infiltrating the wall. There was an evident metaplastic change of the transitional bladder epithelium. Around the right ureteral orifice striking hyaline scarring, with contraction, was present. The remainder of the mucosa was congested and the wall of the bladder thickened. Several submucosal neoplastic nodules, the size of a pea, were found deep in the wall of the right anterior segment of the bladder. In addition, a metastatic carcinoma of the brain, with production of a secondary tumor 6 cm. in diameter, was found in the left cerebellar hemisphere, and obstruction to the cerebrospinal fluid outlet inferior to the third ventricle, with production of an internal hydrocephalus, was present. No other metastases were found.

Comment.—This case is strikingly similar to our own, in that the original tumor had been almost completely destroyed and only a few nodules of carcinomatous tissue were present in the bladder wall. Furthermore, no metastasis was found in the body except the secondary tumor in the left cerebellar hemisphere.

Case 5 (Kretschmer).—The patient was a man aged sixty-two years, complaining of frequency and nocturia for one and one-half years, pain in the left hip of four months' duration, and hematuria beginning three months previously. Examination revealed marked myocardial damage but no clinical or x-ray evidence of metastasis. At cystoscopy a tumor, measuring roughly 10 cm. in diameter, was found behind the right ureteral orifice, extending over the posterior wall. It was elevated above the surface of the bladder, and one area of superficial ulceration was seen. On rectal examination the prostate was normal, but induration of the bladder wall was felt on the right side. At suprapubic cystotomy a tumor measuring 8x6 cm. was found. It projected into the bladder, with an irregular border, and a crater-like ulceration occupied the center. The tumor was firm in consistency, and was evidently infiltrating. It was destroyed by extensive diathermy. Microscopic sections were reported as Grade III, infiltrating papillary carcinoma. The patient was then treated by deep x-ray and radium. He was examined cystoscopically fourteen months later and a recurrence found. Death occurred four months later, and autopsy showed an infiltrating, recurrent carcinoma of the bladder, bilateral hydro-ureter and hydronephrosis, and a brain metastasis.

Case 6 (Beatty).—The patient was a man aged sixty-five years, with symptoms of frequency, nocturia and hesitancy of twenty-six months' duration; urgency and dribbling for the past fourteen months, and hematuria of one year. The patient had lost 24 pounds, and a few weeks before admission vertigo, fainting spells and disorientation had manifested themselves. On examination a hemiplegia, supposedly due to brain metastasis, was present. Cystoscopic examination revealed a tumor occupying the floor of the bladder, extending over the posterior wall and the left lateral wall, and including the vesical orifice on the left side. The tumor was irregular, polypoid, with numerous papillary processes, broad and flat. Several necrotic areas were seen on its surface. On rectal examination definite infiltration of the prostate and marked thickening of the left side of the bladder wall were felt. The patient died ten days after admission to the hospital without operative interference. At autopsy a large, infiltrating, sessile tumor was found on the left and posterior bladder walls and extending to the vesical orifice. In addition, numerous sessile tumors occurred over the remainder of the small, contracted bladder.

Cerebral metastasis was also present. Sections of the bladder wall showed papillary carcinoma, infiltrating, Grade III.

SUMMARY

The interesting features of our case were the remarkable response of the extremely malignant primary growth to deep x-ray and radium therapy; although no gross evidence of tumor was present at careful autopsy study, yet microscopic sections revealed that viable cancer tissue was still present in the deeper portions of the bladder wall. Evidences of brain metastasis became apparent soon after treatment was completed and rapidly determined the fatal outcome of the case. Studies of the literature have shown the rarity of reports of cerebral metastasis in bladder tumor. The similarity of our case to that reported by McKay is striking, in that, in both instances, there was a remarkable response shown by the original tumor to deep x-ray and radium therapy, although in neither instance was the local growth entirely eliminated. Furthermore, both cases developed brain metastasis, which was responsible for the fatal outcome, without evidence of metastatic deposits elsewhere in the body.

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DISCUSSION

DR. HERMON C. BUMPUS, JR. (Pasadena, Calif.): I have looked forward to the opportunity of discussing Dr. Rathbun's paper. The subject interests me deeply. It seems to me that we have missed in the treatment of carcinoma of the bladder the axiom, "The greatest good to the greatest number." I was surprised Dr. Rathbun did not mention the mode of treatment popularized years ago by Dr. Corbus, namely, excision and cautery, or diathermy destruction of the tumor in those cases where resection was impossible.

During 1927 and 1928 at the Mayo Clinic, I had the privilege of treating by transvesical electrocoagulation all the cases of carcinoma of the bladder which were considered inoperable by Dr. Hunt. He first explored the bladder through a suprapubic incision; considering them absolutely hopeless from the standpoint of resection or cystectomy, he turned them over to me. I excised the tumors and then did an extensive destruction by electrocoagulation. Before I left the Clinic, which was after a five-year internship, I wrote to these patients and was fortunate enough to find that five of twenty-nine so treated were still alive and two others had lived over five years, making a total of seven inoperable cases of patients who had been given five years or more of life by this method of treatment.

Upon moving to Pasadena, I discovered the Urological Staff of the Los Angeles County General Hospital held similar ideas as to the efficacy of this type of treatment. Large resection operations were not done; cystectomi[illegible]ere rare, and there had been but few transplantations of ureters.

I was anxious to ascertain, if possible, just what the possibility of cure was in a large county hospital with a changing staff for the patient suffering with tumors of the bladder. Of forty-three treated transvesically by electrocoagulation, eight were alive for three to five years. In the entire group of seventy-seven patients, there were seventeen operative deaths and twenty-five apparent cures of from three to five years. These findings would seem to indicate that this method of treatment offers at least as great a chance of cure as possibility of death. Too often, I believe, the subject

is approached from the standpoint that the condition is hopeless unless the most radical measures are undertaken for its eradication. If the chances of cure were equal to the risk involved in these major procedures, they might be more readily justified, but when the mortality rate incident to the treatment considerably exceeds that of the possibility of cure, it seems as though more conservative measures can be justified in many cases.

DR. BENJAMIN S. BARRINGER (New York, N. Y.): I wanted to speak particularly to Dr. Rathbun's paper. In the first place about the classification of bladder tumors, I think unless you have the whole bladder tumor as you would in surgical removal, no one method of histologic examination gives a true picture. The classification of 1, 2, 3 and 4 of Broders has helped enormously. I think we can compare results over different parts of the country much better by this classification. On the other hand, it does not always give the true picture. For instance, a tumor at the top may show grade 3 and may have a small pedicle and very little involvement of the bladder wall. That is a totally different tumor from grade 3 which involves the bladder wall very seriously. I think we must have in addition to the 1, 2, 3 and 4 gradation, which is a great step in advance, a very accurate clinical estimate of the tumor to make comparison. That goes back to the old papillary-infiltrating classification. I think there must be some combination of the two wherein we may get an accurate estimate of the true picture of the bladder group.

With regard to the treatment, I have always believed that it lay entirely between surgery and radium. The series mentioned by Dr. Bumpus and reported by Dr. Braasch about two years ago at the Memorial is a very impressive series. As far as I know, it is the only series extant of that method of treatment. Certainly the results were very extraordinary.

I believe there have been two very fine series of bladder tumor studies, one by Verne Hunt and one by Beers, in this country. Unfortunately, Verne Hunt's was terminated with his removal to Los Angeles. Beers still keeps his going. Beers' statistics are admirable, something like 25 or 30 per cent five-year cures. I still believe that irradiation therapy is the method of choice, possibly not for tumors of the top of the bladder, but it is as a rule the

method of choice for this reason, that at least half of the patients that are going to be cured, can be cured by cystoscopic application of radium.

With respect to the maximum of four seeds that Rathbun can implant, I wish to state that I have been able to implant at a given time fifteen to seventeen seeds. With the cystoscopic application of radium and the chance of cure, there is naturally no mortality. We have a clean slate as far as that goes. With the suprapubic application of radium, there is some mortality, I suppose around 6 per cent is a fair estimate. Some surgeons have gotten a very high mortality in this procedure and particularly one who reported a mortality of 30 per cent in the suprapubic application of radium. I have discussed this; the reason for it is apparently that the bladder has been mobilized with the thought always in mind of taking the tumor out. Oftentimes when it is found that the tumor cannot be taken out, then radon seeds are applied and the bladder is closed. I think this is absolutely bad technic and it is entirely accountable for this high mortality.

Just one word about the deep x-ray therapy. I am quite convinced, and I may be entirely wrong, that at our present state of knowledge of deep x-ray therapy, deep x-ray is not sufficient to control many bladder tumors. I think that the bladder tumor is radio-resistant much as are the breast, cervix, penis and prostate carcinoma, and while it can be devitalized to a certain extent, it cannot be controlled by external irradiation, no matter what kind of external irradiation we give and no matter how it is given. I have seen bladder tumors controlled by external irradiation. In one case of a bad infiltrating carcinoma of the bladder, the patient had treatment by the 800,000-volt machine. He was controlled for three years. His bladder was clean, but he died of radium burns of both inguinal regions.

I believe that in all cases there has to be some irradiation into the tumor or on the tumor in addition to the external irradiation. That is accomplished by radium.

DR. LEON HERMAN (Philadelphia, Pa.): I would like to say a word about long standing tumors of the bladder with recurrences, and the effect of x-ray treatment. We have comparatively little faith in the latter and have no faith whatsoever in it as a primary therapeutic measure.

Some eight years ago a woman presented herself with a large tumor of the left wall of the bladder. Against our advice she submitted to deep x-ray therapy and returned to us a year later with a note to us saying that she was cured. Re-examination disclosed a tumor identical in size with the original one, and as far as I could tell a most intense deep x-ray therapy over a period of a year had not altered the tumor in the slightest. The opinion in this case from the x-ray standpoint was based on aerocystography. This patient remained well for four years, when she was admitted to the hospital with marked hematuria. Examination showed a flat scar at the site of the resection; there was no evidence of recurrence of the tumor. A few years after this the patient was readmitted with acute retention and we removed a small, solid tumor from the floor of the urethra proximal to the sphincter which was said by the pathologists to be fibroma. Two years later she returned with carcinoma of the urethra and urinary fistula. This patient is alive nine years after the original observation, the tumor in the urethra being apparently under control as a result of radium packs in her vagina. The second remarkable case of long standing tumor is that of a woman who, in all probability, is the first case ever treated by electrocoagulation in Philadelphia. This was in 1912. This woman has outlived three urologists; I inherited her in 1932. From 1912 to 1932 she had been subjected to fulguration approximately every third month. We found a large tumor in the region of the right ureter and innumerable small tumors scattered throughout the bladder. We opened this woman's bladder and resected the large tumor and destroyed the small ones by electrocoagulation. The woman died in 1934 as a result of carcinoma of the liver. The original diagnosis was papillary carcinoma of the bladder which proved recurrent over a period of twenty-two years before metastasis occurred.

Some eight years ago I reported a case of papilloma of the renal pelvis which seems to have been as early as any reported in the literature. The kidney was removed within one week of the initial hemorrhage. The patient remained well for six years when he returned complaining of pain in the back, urinary difficulty and hematuria. This patient had a carcinoma of the twelfth rib on the operated side, a large papillary tumor of the bladder, and an enlarged prostate. This patient has been subjected to deep

x-ray therapy, the tumor resected, and a transurethral prostatectomy performed. He is still living but with widespread metastases.

Some months ago we saw a patient upon whom Dr. Morrissey of New York had operated for early carcinoma of the renal pelvis some ten years ago. The patient was admitted to our service with hematuria ten years after the nephrectomy. There was a large fusiform tumor in the right abdomen and cystoscopy disclosed blood clots projecting from the right ureter. It is our belief that the tumors of the bladder should be resected if possible. Our experience certainly does not justify the use of radium emanation seeds or other palliative treatment in resectable tumors. I have recently seen a patient with a small tumor which seemed to be very slightly infiltrating and in which I employed radium seeds covering fully the infiltrating area. Exploration of this area some months later showed a tumor which had penetrated the bladder wall with involvement of the overlying peritoneum.

PRESIDENT BARNEY: I would like to call on Dr. Denton, pathologist of the Brooklyn Hospital, who has come here at the invitation of Dr. Rathbun to enter this discussion.

DR. JAMES W. DENTON (Brooklyn, N. Y.): There is considerable confusion in the matter of the diagnosis of bladder tumors and I think the pathologists are in a measure to blame for this. While the grading of tumors on a numerical scale may have been of some use, I think it has also had the undesirable effect of the inclusion of some benign tumors in the malignant class. Benign tumors, if they are bulky or flat, present dangers enough independently of any infiltration of the bladder wall. The bases of infiltrating growths are usually poorly vascularized while the bases of benign growths contain plexuses of telangiectatic veins. I have studied several cases in which septic emboli from these veins caused death. There were cases in which it appeared to me that the treatment had been too aggressive.

In my autopsy material of bladder tumors, which consists of ten cases, half of the growths have been benign. I am unable to see what is to be gained by too vigorous treatment of the base of a non-infiltrating tumor. There is danger connected with it.

I realize that it is frequently difficult, on account of inaccessibility, for surgeons to tell whether a vesical growth infiltrates or not. I know from experience with biopsy material that pathologists have the same difficulty because the bases of tumors are frequently not included in the material. Of course, in the case of frank epidermoid carcinoma there is much less difficulty.

To my mind, it would be of distinct clinical advantage and would eliminate many dangers if pathologists would make an effort to divide bladder tumors into three classes. In the first place, simple papilloma; on the other hand, infiltrating carcinoma, and then establish a middle group corresponding more or less to benign epithelioma of the skin. This group would include bulky sessile and other flat tumors which cover considerable areas.

I show you herewith several photomicrographs which illustrate the vascular plexuses which underlie the bases of sessile, benign tumors of the bladder. I have studied the vessels in the bases of these tumors with some interest and have frequently seen septic thrombi in them. In autopsy material I have been able to follow the distant effects of these lesions.

DR. FRANCIS R. HAGNER (Washington, D. C.): I have had the same experience with tumors of the bladder that everybody else has had. Some years ago I reported a method of removing tumors at the top and sides of the bladder that many of you probably have forgotten. I have one friend, an excellent man, who tells me that his results have been worse in tumors at the top of the bladder than any other type. I realize perfectly well we have all seen those cases where there is a small tumor of the top of the bladder on cystoscopic examination, and when the bladder is exposed we find the whole prevesical space involved. One of the weak points in all resections in carcinoma of the bladder is traumatizing the growth. By our method this is obviated. We make a wide dissection and expose the bladder; then introduce a cystoscope through the urethra and outline the growth, putting two sutures in the normal bladder tissue from without. This can easily be seen through the cystoscope by the dimpling of the bladder wall from the pressure of the needle. We then cut between the two sutures, allowing the sutures to remain in the bladder, and grasp the piece to be removed with forceps and evert it. We then dis-

sect it out, taking the peritoneum that covered the growth. We have four of those cases, three located in the top and one on the side of the bladder. These patients have lived over ten years and not one has died of carcinoma. One of them is alive after a period of twenty years. I see him frequently. We do not know the type these cases were because we knew nothing about types at that time, but they were all infiltrating growths of the bladder wall with microscopic diagnosis of carcinoma. By the method cited we do not traumatize the tumor; the slough remains on the growth when it is turned inside out and we do not disseminate the cells in the bladder.

DR. WILLIAM E. LOWER (Cleveland, Ohio): I want to discuss Dr. Colston's paper and report two additional cases of metastatic tumor of the brain, one of which is particularly interesting. In 1922, Dr. Dandy removed a tumor of the brain which had metastasized from a small tumor in the bladder. This small tumor I removed by excision and radon seeds were applied. Almost within a month, brain symptoms began to develop and a diagnosis of metastasis was made and the patient was referred to Dr. Dandy, who performed the operation.

The second case was one Dr. Higgins saw. The bladder tumor was very extensive and the patient died with symptoms of metastasis to the brain. (Slide) This shows the metastasis that occurred in the brain as found at postmortem examination.

Here are two cases in which we have meastasis to the brain even though distant metastasis is not supposed to occur very frequently from bladder tumor. However, it may be that more of these cases occur than we have thought.

DR. WILLIAM C. QUINBY (Boston, Mass.): I extend my compliments to Dr. MacKenzie and to Dr. Colston for their interesting communications.

I feel that it is highly important to discuss the problem of tumors of the bladder because there is no more important subject coming before any urological meeting today than the treatment in all its detail of this disease. It is a matter about which there is as yet no final opinion, and only by free discussion can we eventually begin to bring our ideas of its treatment to something like a focus.

The Association has been very fortunate in Dr. Rathbun's communication. The ideas he has expressed have been in many respects splendid.

One of the perplexities in regard to treatment of bladder cancer, I think, results from our failure to visualize clearly just what is going on. There is no logic in removing a carcinoma of the bladder by any one of the various methods at our disposal if that carcinoma of the bladder has already been disseminated to some region further than the actual wall of the bladder. We must, therefore, determine as clearly as possible this question of extravesical extension before we are in a position to apply any form of treatment. We know from experience that the more benign types of tumor, the papillomata, have not spread beyond the bladder. Accumulated experience shows that these can easily be controlled by local treatment through a cystoscope. But the estimation of the character of any individual cancer of the bladder by observation through a cystoscope is very problematic, if that cancer is beyond the papillomatous type.

Dr. Hagner has just spoken of a patient who showed only a relatively small lesion on the mucosal side of the bladder, but in whom there was extensive propagation of the tumor into the wall of the bladder, seen only on opening the bladder, or on approaching the bladder from outside. This is quite a common occurrence. So, therefore, in justice to this subject and to the patients we must be much more ready to make a definite surgical exploratory operation than we have been in the past. This I have advocated during the last two or three years. We cannot rest satisfied with our own personal opinion of what the tumor looks like; neither can we draw too definite deductions from a filling defect in the x-ray. A benign tumor of the bladder, if it is large enough, will cause a marked filling defect which from the roentgenologist's point of view seems as though it were very extensive, though it may not be so. And, *per contra*, the invasive tumor may cause only a small defect in bladder outline.

So what shall we do? We must investigate these patients by surgical operation as a very important preliminary step in evaluating each individual case.

There is a tendency, I think you will all admit, to apply one form or another of treatment to those patients according to whether the pathologist reports that the tumor is of second, third, or fourth

grade of malignancy. Well, this grading isn't of great significance, though it does have a definite prognostic value in regard to your ability as a surgeon to cure the patient. It cannot safely be an index of what form of treatment you should apply. All cancer is bad; it is very bad. You have got to excise it, for even if it is only grade 2, nevertheless it is definitely cancer, and is going eventually to kill the patient if it is not removed. Maybe a longer time will pass before recurrence, but if not wholly eradicated you are not going to cure the patient. Therefore, the gradation of the malignancy of the tumor should not, in my opinion, influence the type of treatment used, always, of course, excluding the papilloma.

The position of the tumor, however, should very definitely influence the type of treatment used. Unfortunately, you know well that many of these tumors are prone to occur in the lower bladder segment and this makes them all the more difficult. The type of treatment which treats a tumor in the lower bladder segment must necessarily differ from the type of treatment applicable to a tumor in other portions of the bladder.

I cannot agree with Dr. Denton's hopes based on the question of occlusion of immediately adjacent veins. The occlusion of immediately adjacent veins, whether by ordinary thrombosis or by malignant thrombosis, is a factor in the growth of any tumor. It is one of the difficulties that the surgeon has to meet, but it should, in my opinion, in no way influence treatment. It merely means that the excision or whatever treatment is used must be more extensive.

In closing I must agree with the remarks of Dr. Bumpus regarding the great value of total cystectomy. When indicated the results are better than those following any other form of treatment. It is not a procedure, however, which can or should be universally applied to every case of bladder cancer. For instance, during the last year at my hospital, approximately, there have occurred about four total cystectomies out of five or six times that number of cases of cancer. I don't wish to give the impression that I am going to remove every patient's bladder the minute I find it has a cancer in it. There are many other forms of treatment than that.

I do wish, however, to pay my respects to radium. Radium as an *adjuvant* in the treatment of cancer of the bladder, in my experience, is splendid. As a single method of treatment, I hate it. I think it gets more patients into more grief than can be at all justi-

fied. Dr. Barringer and those at Memorial Hospital will tell you there is a possible 15 per cent cure. I say, "Yes, 15 per cent cure is fine—I congratulate them—but what the devil happens to the other 85 per cent?"

DR. BARRINGER: Twenty-five per cent cure.

DR. QUINBY: What happens to the other 75 per cent? They die much more miserably than they would if you had made some other type of effort to cure them. I have a case in point, a patient whose bladder tumor seemed to be especially applicable to radium. Radium was used on two occasions. She has exchanged her bladder with a cancer in it for a complete cloaca. She is unable to take care of herself and has had to have a private nurse for about three and one-half years, and is a social pariah. There is no floor of her bladder left. It empties into the vagina and there is also a communication between the rectum and vagina. So, as I say, she has reverted to those types possessing a cloaca but one which is without her control.

DR. CHARLES M. MCKENNA (Chicago, Ill.): I have enjoyed this symposium on carcinoma both of the prostate and of the bladder, and I was very much interested in the last speaker speaking about the management of that other 75 per cent. That is one point that we did not take up. After we have irradiated these organs and after we have resected them and dissected them and transplanted them and still have the carcinoma, there is one point we still have that gives us all a considerable amount of trouble and the patient a great deal more trouble, that is the question of the management of pain. I would be interested to know how many have tried the use of absolute alcohol intrathecal injection for the control of pain of patients suffering from carcinoma of the bladder or carcinoma of the rectum. I will say this, in our series that we published last year, we had a high percentage of relief of pain but as we went on in that series, the relief of pain was less. But I will say that if you had ten patients and only one of those patients got relief of pain, and it was a total relief of pain, it is well worth trying. In those cases when it does work, it works well and those patients will go to complete death without any pain.

I would be interested to know (of course, I don't know) why it has worked well on one and not well on the other. I should be very much interested to hear from someone. Dr. Higgins has obtained relief and we in Chicago; we have plenty of them to try it on. I would be interested to hear from somebody else to find out whether they have had any total relief of pain with those patients suffering from carcinoma of the bladder or prostate.

PRESIDENT BARNEY: If there is no more discussion of these papers, we will ask Dr. MacKenzie to say the final word.

DR. MACKENZIE: I have nothing further to add.

PRESIDENT BARNEY: Dr. Rathbun!

DR. N. P. RATHBUN: I just want to get up to thank the gentlemen for the very liberal discussion. I think I was very fortunate in my choice of a subject. I am willing to admit that the subject, rather than the paper, elicited the most discussion.

I only wish to refer to one point in closing and that is classification. I admit, of course, that Broders' grouping has been of great help, but I still think that it has led to a great deal of confusion. Those of you who were at the Boston meeting heard Major Dart in his report on the up-to-date news on our registry, suggest a modification of that grouping, which I think is a step forward. I shall not attempt to speak of it here, you all read it in his report.

DR. J. A. C. COLSTON (Baltimore, Md.): Dr. Lower's case that he has just demonstrated is one of the only complete cases of brain metastasis from primary carcinoma of the bladder that we were able to find in the literature. I did not have time to refer to this case in my presentation, but it will be included in the original paper.

We have not tried intrathecal injections of alcohol, as suggested by Dr. Quinby, to alleviate the extreme suffering which occurs in the terminal stages of extensive infiltrating carcinoma of the bladder. It would certainly seem that this method would have a definite place in the treatment of these distressing cases.

During the past year I have seen nine patients with extensive infiltrating growths, four of whom died with the usual suffering.

In four other cases in which radium and deep x-ray had failed to control the growth, total cystectomy was done; in two, ureteral sigmoidostomy was performed and in the other two, in both of which the ureters were dilated, a cutaneous ureterostomy was done. It is, of course, too soon to determine the ultimate results of these cases, but in any event, all of these individuals have had complete relief of the distressing and intolerable pain that they were suffering, so that my experience with this type of case has stimulated me to consider this extensive operation in cases of any extensively infiltrating cancer of the bladder which did not respond to deep x-ray and radium.

TWENTY-FIVE YEARS OF UROLOGY

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At this fiftieth anniversary of the birth of the American Association of Genito-Urinary Surgeons it seems appropriate to relate what has been accomplished by the Urological Department of the Massachusetts General Hospital since its foundation by Dr. Hugh Cabot in August, 1911, twenty-five years ago. Dr. Cabot was Chief of the Department until his resignation in 1920. Since that date the writer has had the honor to hold this important position.

The figures and tables are presented here, often without explanation, and always without apology. Some are apparently contradictory, but they must be taken at their face value. The work has been shared in by the entire staff, each one in his turn, some having more ability and experience than others. It is believed that because of this, and because of the fact that this review covers a long period of time, it represents a very accurate picture of what any similar group of conscientious and well-trained urologists working harmoniously can accomplish. It is probably also true that a similar survey of the work of other clinics, comparable to ours in size and in the nature of its material, will show about the same results.

This clinic began life with a large and flourishing Out-Patient Department and with ten beds in the House. After a short time it became apparent that more beds were needed, but appeals to this end met with no response until 1929, when we were given ten more beds. Even these were not sufficient. This year, as a well-deserved anniversary present, and to satisfy our constant demands, the trustees graciously brought the total number of beds to twenty-five.

For the purposes of this review, all of our 5,263 records have been studied and tabulated by my associate, Dr. E. Ross Mintz, to whom much praise and gratitude is due for a great deal of hard work. Another member of the Staff, Dr. Richard F. O'Neil, has written a very complete history of the various changes in and developments of the department. This will be published elsewhere.

A few general facts are of interest. As will be seen in Chart 1, the surgical services continued to operate on a considerable number of urological cases until 1924, after which time they withdrew completely from our field. Incidentally, many of these cases had been carefully worked up by our department before operation by the general surgeon. It is also true that during the years up to about 1924 there were on the hospital staff a number of older surgeons who had always done whatever urology came their way,

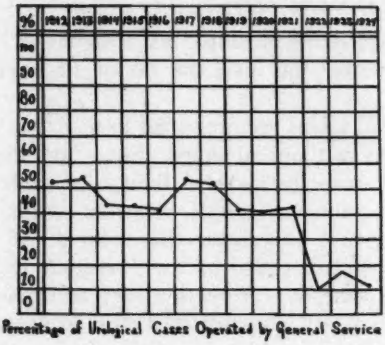

Chart 1

and who indeed were quite capable of handling much of it. More recently most of the younger surgeons find themselves without the training and experience which is now necessary for urology.

The general operative mortality of our service has naturally varied from year to year, but has averaged about 4 per cent. The same may be said of our percentage of mistaken diagnoses, which has also hovered just above or just below 4 per cent. Most of the mistakes of diagnoses have involved the scrotum, a well-recognized source of perplexity and error.

Success in obtaining autopsies has varied from time to time, depending among other factors upon the personality and tact of our resident surgeon. In one or two years it has been as high as 90 per cent, last year about 65 per cent. The general average has been about 75 per cent.

Chart 2 shows graphically the rapid increase in the number of

patients admitted to our service, over 100 per cent more in the last than in the first five-year period.*

It has been not only unnecessary but impossible to do more than touch the "high spots" in this survey. Thus scrutiny has been directed upon (1) prostatic obstruction; (2) bladder pathology, calculous and neoplastic; (3) kidney pathology, this including neoplastic, infectious (both tuberculous and pyogenic), calculous, ptotic, and miscellaneous; (4) genital tuberculosis; (5) stricture of the urethra; (6) cancer of the penis.

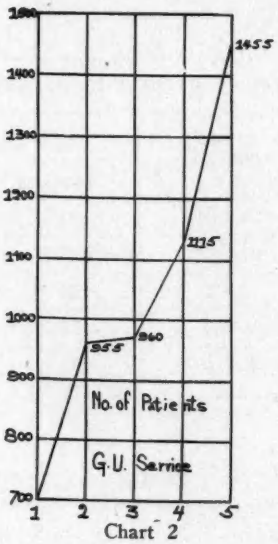

Chart 2

The matter of prostatic obstruction is summarized in Tables I and II. There was a total mortality of 19.4 per cent, this including benign and malignant, operated and unoperated cases. The percentage of malignancy averages lower than that in certain other series of cases, but at times in our own experience has risen to nearly 25 per cent. One is impressed with a mortality of 33.4 per cent in cases where no operation at all or only a cystoscopy was done. This shows the folly of postponing proper treatment

*In this, as in Charts 3, 4, 5 and 6, the vertical lines indicate five-year periods.

TABLE I. PROSTATIC OBSTRUCTION

	No. Cases	Deaths	Per Cent Mortality
Total	1124	219	19.4 (17.7 Malignant)
No operation (cystotomy)	308	103	33.4
Operated all methods	816	116	14.2
Benign obstruction	710	94	13.2
Malignant obstruction	106	22	20.7

MORTALITY OF TYPE OF OPERATION

5-Year Periods	Perineal	Suprapubic	
		One-stage	Two-stage
1911–1916	18.7%	24%	12.4%
1916–1921	20.0%	10%	25.5%
1921–1926	8.5%	24.1%	18.1%
1926–1931	5.6%	8.3%	8.9%
1931–1936	8.9%	10%	24.2%

TABLE II

No Operation				Resections			
Benign		Malignant		Benign		Malignant	
11	4	2	1	60	4	30	6
9	2	6	2				
22	2	20	5				
32	17	13	0				
50	12	18	6				
124	37	59	14				
29.8%		23.7%		7%		20%	

Perineal operation	2
Cystotomy	10
1 Stage	2
2 Stage	2
Litholapaxy	4

for too long a time. Equally striking is the much greater mortality throughout of the malignant cases. Advocates of the perineal operation may well be cheered by the mortalities shown as compared with those of the suprapubic operation, whether it be a one or two-stage procedure. The fact that the average mortality of the two-stage operation is higher than that of the one-stage indicates that those having the two-stage procedure were the poorest risks. All of which has taught me, at least, that the longer the pre-operative drainage, the lower will be the mortality. Wonder will be expressed at the very few resections which we have done and at

TABLE III

BLADDER NEOPLASM

Total	351 cases	Cancer	307
		Papilloma	44
Operative Mortality			22%
No Operation	54	Mortality	20%
Diversion of Urinary Stream		Skin	14
		Bowel	17
Total Cystectomy	15		

VESICAL CALCULUS

Total	203 cases	Benign Prostate	66	Cancer	4
Cystotomy	38	5 deaths		Mortality	13%
Litholapaxy	96	2 deaths		Mortality	1.8%
No Operation	3	1 died in hospital			

the results, including not alone the mortality but the number of additional operative procedures to which these patients were submitted. All we can say is that Boston is a conservative town, slow to take up new ideas. Also it is possible that the enthusiastic and indeed highly-skilled resectionists who today report mortalities of 1 or 2 per cent did no better than we in their first hundred or so cases.

The subject of bladder pathology is well covered in Table III. Again one is impressed, as in the prostatic cases, by the large number of patients who were too far gone on admission to have anything more than palliative and supportive treatment. The operative mortality of 22 per cent includes all types of recognized operative procedures, some with, some without the use of radium.

Unfortunately, no details were gathered of the cases having diversion of the urinary stream or total cystectomy.

As regards vesical calculus, it is striking to note its great infrequency in the presence of cancer of the prostate. Even more impressive is the tremendous difference in the mortality of litholapaxy as compared with cystotomy. Our fondness for litholapaxy may be explained by the fact that this procedure was perfected and given to the profession in 1878 by the late Dr. Henry J. Bigelow, Visiting Surgeon to the Massachusetts General Hospital from 1846 to 1886. We of today still use his original technic

TABLE IV. RENAL DISEASE

	All Cases	Operations	Deaths	Mortality	No operation	Deaths
Tuberculosis	296	212	11	5.2%	84	3
Tumor	70	65	9	13.8%	5	1
Stone	439	419	18	4.3%	23	5
Hydronephrosis	46	46	0	0	0	0
Pyonephrosis	76	59	10	17.0%	0	0
Nephropexy	69	69	1	1.4%	0	0
Others	70	70	8	11.4%	0	0
Total	1066	940	57		124	9
Total Deaths	6.19%			6%		7.2%

and, so far as we can get them, his original instruments. The art of crushing a stone in the bladder has been handed on from one generation of us to the other, and I hope always will be. While not without its contra-indications and quite capable of producing harm, we believe that in careful and experienced hands it is the safest and best procedure, and that it should be more widely used. This view is strengthened by the knowledge that residence in the hospital after litholapaxy averages about a week, as compared with about three weeks in the event of a cystotomy.

Turning now to kidney pathology, which includes ureteral calculus, the product of our clinic is well shown in Tables IV and V, in which the facts presented speak for themselves. One or two items deserve mention. In the last two columns in Table IV the large number of cases of tuberculosis unoperated may be accounted for by the statement that these were mostly with bilateral involve-

ment. The one death where nephropexy was done occurred during the operation (a personal case), and was undoubtedly due to the anesthetic (gas-oxygen), as at autopsy no demonstrable cause of death could be found. The heading "Others" in Table IV includes all varieties of kidney pathology not otherwise listed. The portion of Table V dealing with the kidney and ureter gives more details of the cases of neoplasm and calculus. We are not

TABLE V. KIDNEY AND URETER OPERATIONS

	Total	Operation	Deaths	Mortality
Tumor	70	Exploratory only 12	2	16.6%
		Nephrectomy 53	7	13.4%
Hydronephrosis		Nephrectomy 46	0	0
Calculus	439	Nephrectomy 151	9	5.9%
		Pyelotomy 220	5	2.2%
		Nephrotomy 48	4	8.3%
Ureteral Calculus		Ureterotomy 189	5	2.2%
Stricture of Urethra	237	Cystotomy 21	15	6.3%
Genital Tuberculosis	144	Epididymo-Vasectomy 138	0	0
Carcinoma of Penis	47	41		14.6%
Groins dissected	25	(8 malignant; 32%)		

at all dissatisfied with our results in the operations for calculus, either taken as a whole (5.9 per cent) or where pyelolithotomy was done (2.2 per cent). The term "nephrotomy" in recent years usually means the incision of a single calix or perhaps of one or the other pole of the kidney, as contrasted with the more or less complete bisection of the kidney which was formerly employed. The results of ureterotomy for stone (2.2 per cent) are quite as gratifying as those of pyelotomy.

At this point it may be interesting to glance at Charts 3 and 4. In Chart 3 the sharp drop in the number of operations for renal tuberculosis, in spite of over 100 per cent more patients admitted, means only one thing—namely that tuberculosis itself is decreasing, and perhaps that its earlier recognition and better treatment prevent renal involvement. The rapid rise in the number of cases of ureteral calculus, shown in Chart 4, may perhaps be accounted

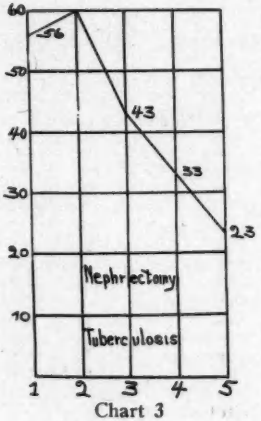

Chart 3

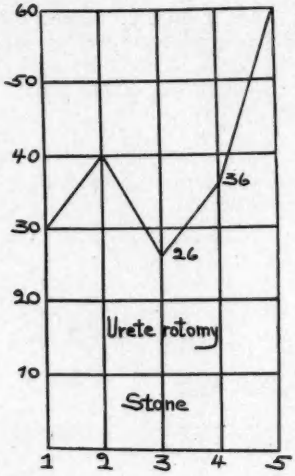

Chart 4

for by the better diagnostic facilities now available. More and more use is being made, even by the general surgeon, of the x-ray and of the retrograde or intravenous pyelogram. One must also not forget the ureteral catheter, especially one which is armed with a wax tip. I think there is no doubt that in the not too distant past in many cases which were diagnosed as appendicitis or some other abdominal condition the patients were in fact suffering from ureteral, possibly from renal calculus.

Referring again to Table V, one sees that the general mortality of urethral stricture is not excessive. It is noted that in twenty-one of these cystotomy was elected, usually for the improvement of the patient's general condition before the stricture itself was operated upon, but sometimes because retrograde catheterization

was necessary. It may be added that in seventeen of the whole series, so-called "extravasation" was recorded, while in sixteen the stricture was of traumatic origin. The most interesting and important feature of the stricture group is shown in Chart 5. Here again, as in renal tuberculosis, fewer operations were done on relatively more cases. In other words, the urologist has found not only that gradual dilatation is possible in more instances than

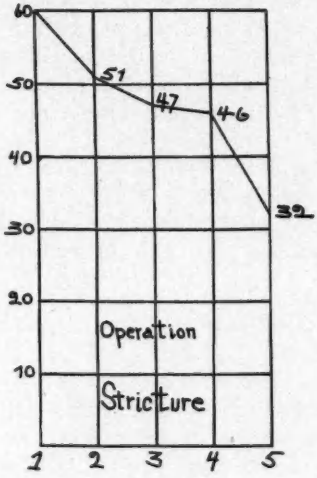

Chart 5

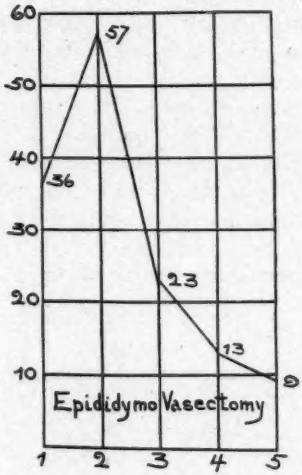

Chart 6

he formerly thought, but also the results are as good or better.

Two more items are now to be considered. In Table V it is seen that there was no mortality among 138 cases of epididymo-vasectomy for genital tuberculosis. This is due, I think, to the almost exclusive use of local novocain instead of general or spinal anesthesia. Many of these patients had bilateral involvement, a few underwent orchidectomy where it seemed to be indicated. In no instance have we thought it necessary or wise to perform the radical operation advocated by Young, nor, on the other hand, have we subjected these patients to any of the so-called palliative and non-surgical measures. We still believe that epididymo-vasectomy is the proper procedure, this opinion being substantiated by the good results found in the follow-up of these cases. As in

renal tuberculosis, there has been a definite decrease in the number of cases of genital involvement, as shown in Chart 6. In fact the curves of this and of Chart 3 almost parallel one another.

Finally, it is at least of interest to note that where the groins are dissected in cases of penile carcinoma, malignancy is found in only about one-third. The figures are shown in Table V. This corroborates my observations on this disease made many years ago.

In closing this review I wish to say that it is to be noted that these figures apply only to patients in the open wards of the hospital. It is well recognized that the results with material such as this are far less satisfactory than with a similar number of private patients. It is regrettable that many rare, interesting and difficult cases could not be included in this brief report. Some of them at least have been or will be dealt with in separate communications. Finally, the reader's indulgence is asked if he finds minor discrepancies in the figures presented. I am aware that such do exist, but the errors are small and few and seemed to be unavoidable in the scrutiny of such a large mass of material.

DISCUSSION

PRESIDENT BARNEY: As I said, this is an historical occasion. It is our fiftieth anniversary and it seemed to me it would be very nice if we could have somebody here who remembered back fifty years and who would tell us a few reminiscent details. Dr. Francis Watson was taken in on the occasion of the first meeting in 1887. Unfortunately, Dr. Watson has had a cerebral accident from which he is fortunately recovering and is about to depart, I understand, for Murray Bay.

Dr. Wishard, of Indianapolis, was elected at the third meeting in 1889, and by a great deal of correspondence and hounding of his medical attendant and getting his son here as our guest and also to act as his nurse, you might say, we are fortunate in having Dr. Wishard here with us. I think we would all like to hear a few words from Dr. Wishard. (Applause.)

DR. WILLIAM N. WISHARD (Indianapolis, Ind.): Thank you very much, Mr. President.

Dr. Watson is not here and I confess a certain feeling of loneliness that I hope you will live long enough to realize, when you think of the fact that there is but one other living member of the American Association of Genito-Urinary Surgeons at the meeting which I first attended. It was my privilege to be invited to the meeting at Washington City, in 1888, and to hear that history-making paper of Dr. Watson's on "Operative Treatment of the Prostate," which afterwards, the same year, was embodied in a brochure which was at the time, and I think has been until now, a very classical outline of what we had to undertake when we attempted to deal with the prostate.

Our president, Dr. Barney, has asked me to say a word about the men whom I had the privilege of knowing at that early date. Four or five stand out very prominently. I think we are indebted to the genius and understanding and vision of Dr. Edward L. Keyes, Sr., for the formation of the American Association of Genito-Urinary Surgeons. It was in 1886 that a half dozen men, three of whom were genito-urinary surgeons and three of whom were dermatologists and syphilographers, met at Dr. Keyes'

office. You are of familiar with the history of that formal organization which initiated a very serious attempt at solving problems that we are met today to consider.

Dr. Keyes had a very thorough way of doing things. I will not attempt, as I feel inclined to do, to enlarge upon his admirable and understanding qualities.

At the first meeting which I attended in 1888, I recall as being present besides Dr. Keyes, Drs. Otis, Sturgis, Taylor and others. I am quite sure there were not more than a total of fifteen in attendance at this Washington meeting. During the intervening years the attendance and interest have constantly increased. This was a period when for several years the views of Otis on urethrotomy and urethral caliber had been subjects of intense controversy.

May I say a word about the literature of that day? It is historically accurate, I think, to state that we had very little urological literature in America up to about 1873 or 1874. It is true the work of Gross and that of Gouley and one or two other small books had been written, but we had no concise, systematic, really teaching textbook until the edition of 1874 prepared by VanBuren and Keyes. The various editions of that work that have come down through the years since, you are familiar with.

Quite a number of excellent works on urology have since been written by American authors and have enriched the literature of urology. The annual program of this Society and of the American Urological Association and its various branches, and the Urological Section of the American Medical Association are constantly contributing to the literature of this department.

I want to say a word about the interpretation as to what constituted surgical urology fifty years ago. Perhaps I can illustrate that better by telling a story about an inqury the dean of our own medical school at Indianapolis made of me on one occasion when he said on my leaving the City Hospital of which I had been superintendent several years, "What are you going to do?"

I replied, "I am going down town and open an office."

He indicated that I might have a teaching position in the Medical School if a vacancy occurred and asked as to my desires in that direction.

I remarked that I had been interested in a study of genitourinary surgery and if he didn't mind and if he was willing to

carry out his suggestion and the faculty should give me recognition, I would like a part of his chair. He was professor of general surgery, of which urology was a part.

"If you will establish a chair of genito-urinary surgery and put me at the head of it, I will appreciate it. I ask that also because I know that it is a department in which you are not particularly interested."

He threw up his hands and said, "I will be glad to recommend you but what do you want with that? You will be nothing but a respectable venerealist."

That was the conception of genito-urinary surgery at that time, about 1886.

Historically it is true that this Association has paved the way and has opened a path of understanding and inquiry to serious study and accomplishment in the department of surgical urology that is distinctive and peculiar and different somewhat from that of any other organization organized along similar lines. You have limited the number of membership from the very beginning. Sometimes I have thought that that was a little too strict, but as I have studied the work of this organizaion from year to year, it has impressed me with the fact that that limitation has been worth while. Somebody has defined the word "unity" as being correctly expressed by "differing without controversy." There has been a happy emphasis of that definition of unity in this Association.

You are getting to be very much like the worth while spirit of unity without controversy that is so beautifully exemplified in the City of Boston. Among the very considerable number of men I have met from there, I have never heard of them quarreling with each other about anything, and that seems to be the condition all over the country so far as this organization is concerned.

May I mention one thing as to the meetings? In the early meetings of the American Association of Genito-Urinary Surgeons, the first one of which I attended, in 1888, at Washington City, Dr. Keyes was the moving spirit and Dr. R. W. Taylor was a sort of general manager. The latter was a dermatologist and a syphilographer of distinction in those days, but he was not a genito-urinary surgeon, although he held a teaching position in that department. He was an outstanding man professionally, and is mentioned as indicating the fact that in its early history this

organization was composed of dermatologists as well as genito-urinary surgeons. However, Dr. Taylor wrote a book on genito-urinary diseases. Because of his very careful scrutiny of every paper and everything, new or old, that was presented to the American Association of Genito-Urinary Surgeons, I felt a certain timidity about reading a paper which I had been invited to do. I had been received as a member in 1889. I had attended by invitation the meeting of 1888. So it was up to me, when I was asked to read a paper in 1891, to be very careful and attend to my P's and Q's.

Incidentally and very casually, after reporting some seventeen or eighteen cases of prostatectomy, I mentioned the fact that in the first of these, and in some subsequent cases, I used visual observation of the prostate in the application of a cautery knife which I had devised. The first attempt was in 1890. You will find it reported in the *American Journal of Cutaneous and Genito-Urinary Diseases* for March, 1892. But this report was not very impressive as to the cautery. The definition of unity that I gave a while ago applied. There was unity of feeling without controversy; in fact, they didn't say anything about it. (Laughter.) They did happen to comment on the surgical efforts that I made aside from the cautery in the matter of suprapubic and perineal enucleation of the prostate. I continued using that type of cautery a good many years, some ten or twelve years as I recall, during which period I applied it from time to time and ultimately developed a new instrument especially for that purpose which was also used for another ten or twelve years. It was an instrument with a light on the distal end and an observation window, and a movable and adjustable cautery which some of you may have seen illustrated when it was published. When I read a paper before this Association, in 1902, at Atlantic City, I also presented my newly devised cautery instruments at that time. The same unity of spirit was manifest again. I don't think that it was regarded very seriously. I certainly regarded it as having a limited area in the scope of our work and yet as having value in selected cases. Visual observation in using the cautery nevertheless has come to its own, if not more, in recent years.

I think we have had a very constant feeling of interest, scientific thoroughness, carefulness of investigation and fairness of con-

sideration in all things that have come before this Association. My own privilege, and I regard it a very great privilege, of being an early member of this Association is one that I prize most highly.

I wish, as I said a while ago, that our friend, Dr. Watson, could be here. It was his paper on the prostate, entitled "Surgery of the Prostate," which he read at Washington City, in 1888, the first meeting that I attended, in which he presented quite a number of photographs that he had made from specimens or drawings. I remember he had a string on one side of the room passing across to the other, and it was full of his illustrations that have become classical in the literature of genito-urinary surgery, at least they were so highly regarded that they were subsequently copied by many authors. As I recall, he also reported two operations on the prostate, one a suprapubic prostatectomy and the other a median perineal division of a prostatic bar. It is Dr. Watson to whom we owe great credit.

In closing, may I suggest the feeling that we might do well to send Dr. Watson a message of very cordial greeting today? (Applause.)

PRESIDENT BARNEY: Gentlemen, we must carry on the torch that those fine old gentlemen have handed to us.

SECOND DAY, MAY 26, 1936

NEPHROPEXY WITH LIVING SUTURE AND RENAL SYMYPATHECTOMY

J. C. McCLELLAND, M.D.
Toronto, Canada

While a house surgeon on general surgery, I was much impressed by a statement of my chief that kidney fixation operations carried only 20 per cent cure and that it was looked upon as a very questionable procedure. In recent years our methods of kidney investigation have been advanced by the use of both retrograde and intravenous pyelography to such a degree that we can get a very accurate conception of the actual condition of the kidneys, their pelves and ureters. The use of the upright pyelogram with the patient in the erect position is also of great aid in determining the position of the kidneys. By our improved methods urologists can diagnose conditions more accurately and have a much better chance to recommend the proper treatment than the surgeon who has to diagnose and treat kidney conditions without the use of the pyelogram.

SYMPTOMS

The outstanding symptom is pain. This may be dull or sharp in character, present in the flank radiating to the back in the costomuscular angle. Sometimes it is accompanied by nausea and vomiting. Chills and fever may be present at intervals together with some frequency and burning on urination. One of the patients in this series had been admitted to hospital with pain in the flank and jaundice. This was investigated and the gall bladder explored without finding the cause of the jaundice. Some patients had previous operations on the gall bladder, duodenum, bowel and appendix without complete relief of symptoms.

These patients are usually very high strung, debilitated and nervous and it is often thought that their symptoms are exaggerated. This makes it much more difficult to evaluate their disability and decide if an operation is necessary.

DIAGNOSIS

The diagnosis is made by the history of intermittent attacks of pain and the finding of the floating kidney. In the erect position

the kidney can be felt coming down in the flank. In the prone position it descends into the flank and can be held there. Pyelograms taken in the erect and horizontal positions show the complete excursion which the kidney makes from the prone to the erect position. The ureter is usually kinked when the kidney is down and there is a very slight dilatation of the kidney pelvis.

INDICATIONS FOR OPERATION

A large number of patients with nephroptosis are seen in our wards each year but the only ones who are operated on are those who feel incapacitated by their symptoms and who cannot carry on with their work unless something is done to relieve them. The majority have had lower abdominal belts and also exercise to increase the capacity of the upper abdomen. Some of these patients are relieved by support and exercises while others have their symptoms continuing. Persistent pain, lack of relief by support and the general feeling that she cannot do her usual work forces one to some radical form of treatment for relief of the patients. Operation is recommended.

OPERATION

In the belief that a sling of fascia could be used to hold the ptosed kidney up in position the following operation was devised and carried out with success in eight cases.

The kidney is exposed with the usual S-shaped incision starting above and behind the costomuscular angle and ending slightly above and medial to the anterior superior spine. This must be carried parallel to the last rib but 1 inch below it to allow for a shelf of fascia and muscle extending from the last rib backward to the erector spinæ muscle. This is the lumbo-dorsal fascia attached to the last rib above, being the continuation backward of the three muscle layers of the abdominal wall. Posteriorly it splits to enclose the erector spinæ muscle and the quadratus lumborum muscle. It is also called the external arcuate ligament. Superficial to this ligament is the cut edge of the latissimus dorsi muscle. One is careful to avoid injury to the nerves which are displaced downward.

The kidney is delivered and freed from the surrounding fat. The pedicle and ureter are cleaned of fat. These kidneys always have long pedicles and an effort is made with a non-toothed forceps to dissect the nerves in the pedicle. These are identified as small

grey strands following the course of the blood vessels. They have been seen to bifurcate following the bifurcation of the renal arteries. These nerves are torn or cut. It is not a complete removal of all the nerves, as I do not feel that this is possible, as a few may remain unrecognized, but all that can be seen are removed.

While this is being done an assistant removes a strip of fascia lata from the thigh 10 inches long and ¾ inch in width. This is cleaned carefully of all fat and kept in a basin of warm normal saline solution until ready for use.

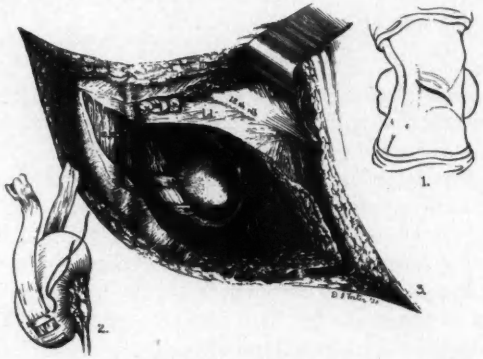

Fig. 1. Drawing of the fascia as it surrounds the lower pole of the kidney and is fastened to the costolumbar fascia. (See text for full description.)

The kidney is held up in position with the hand and a position chosen on the lower pole of the kidney to cut straps to thread the fascia through and form a sling as shown in the diagram. The fascia is fastened to the straps by means of No. 0 plain catgut through the edge of the fascia and the kidney capsule. In this way the fascia is threaded through the straps of kidney capsule, is fastened and forms a sling of the lower pole. The ends of the fascia are drawn through the external arcuate ligament as close to the erector spinæ muscle as they will go, tied in a double knot and oversewn with plain catgut to ensure that the knot will hold. In this way the lower pole of the kidney is tilted outward and thus better drainage of the pelvis is obtained. In one case the kidney could not be fastened as high as I would have placed it as the

ureter was on too much tension and the kidney had to be lowered.

The wounds are closed, leaving in a small thyroid tube which is withdrawn at the end of twenty-four hours.

COMPLICATIONS

Two of these patients developed a phlebitis. The first had a phlebitis in the femoral vein on the side opposite to that operated on and away from the side where the fascia was removed. The second had a phlebitis in the popliteal vein on the side operated on. Both made complete recoveries but there was a delay in their convalescence. Otherwise there was the usual postoperative convalescence of a kidney case.

RESULTS

In the eight patients operated on the results were excellent. In only one was there a pain left. This was the patient who had the tight ureter which had to be loosened at operation. She was a very poor subject but her pain was gone nine months after operation. In the others the pain was gone completely and the gastrointestinal symptoms cleared also. Some of these patients were able to eat raw fruits with comfort, which they had not taken for years. Uroselectan pyelograms taken in the erect position showed the kidneys operated on to be in good position. They emptied well and the slight hydronephrosis was decreased. No infections occurred.

CONCLUSIONS

1. Nephropexy with living suture is a procedure which can be used to cure a floating kidney.
2. Renal sympathectomy is also of use in these patients.

SIGNIFICANCE OF FILLING DEFECTS IN THE UROGRAM

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Apparent filling defects in the outline of the renal pelvis, renal calices and ureter are frequently seen in the course of routine excretory urography. Many of these have no clinical significance. In fact, complete visualization of the renal calices is not obtained in most cases. In some cases the filling defect may be visible in the first urogram but may disappear in subsequent urograms, or vice versa. In many excretory urograms peristalsis is so active that visualization of the renal calices or pelvis may be extremely fragmentary, which in some cases may be explained by some form of imbalance in sympathetic innervation. Further difficulty in interpretation may be caused by overlying intestinal shadows, which often simulate filling defects in the renal pelvis. That these various apparent filling defects are frequently without anatomic basis is shown by their subsequent disappearance in a retrograde urogram. On the other hand, filling defects observed in the excretory urogram, when confined to the renal pelvis or to one or two renal calices and when they persist in the retrograde urogram, may be the only urographic evidence of an organic lesion and should be regarded as important evidence. Fragmentary visualization of the renal calices in the excretory urogram may disguise an actual filling defect and if a neoplasm is suspected, a retrograde urogram should always be made.

Filling defects of organic origin which involve the renal pelvis, renal calices, and the ureter are caused by a great variety of conditions, including tumor, blood clots, lithiasis, cicatricial changes, congenital deformity, postoperative deformity, granulomas, pyeloureteritis cystica, air bubbles, reflex spasm, and tuberculosis.

Renal tumor is a common cause of filling defects in the outline of the renal pelvis and the renal calices, which may be visualized in the urogram. Although a cortical tumor usually affects the outline of the calices more than that of the renal pelvis, it may invade the pelvic lumen to a variable degree and occasionally will

obliterate it. Compression of the walls of the renal pelvis by a cortical tumor, without actual protrusion, may contract and distort the pelvic lumen so as to cause a bizarre, narrow outline in the urogram. Partial obliteration and flattening of the adjacent calices, without deformity in the pelvic outline, is often observed with both renal cysts and neoplasm, although it is more frequently observed with the former lesion. A filling defect caused by papil-

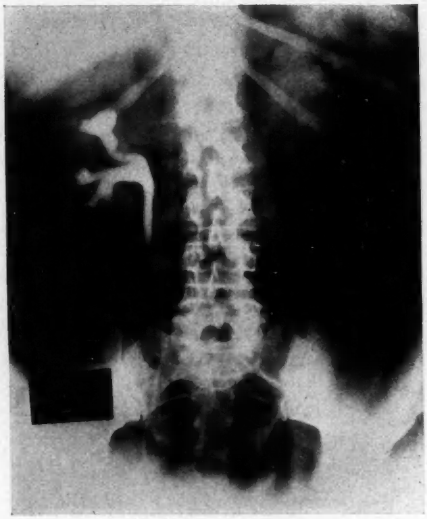

Fig. 1. Filling defect in upper calix, suggestive of neoplasm; at operation, an overlying perforated gall bladder was found.

lary epithelioma of the renal pelvis is usually confined to the renal pelvis itself and is often accompanied by a variable degree of pyelectasis which involves all of the calices as well as the pelvis. A filling defect which involves one of the calices so as to obliterate its outline and which also involves the pelvis is occasionally observed. It may be impossible to distinguish between the filling defects caused by cortical carcinoma and papillary tumor of the renal pelvis. An extensive chronic abscess in the renal cortex, or carbuncle, may cause a filling defect involving one or more calices

or the pelvis of the kidney and the defect may be difficult to distinguish from similar deformity caused by a renal neoplasm.

Failure of visualization of the renal pelvis as the result of reflex disturbance of renal function caused by stone in the pelvis of the kidney or in the ureter is frequently observed. As a rule, this condition is temporary and disappears shortly after removal of the stone, when the renal function returns to normal. In cases in which failure of visualization in the excretory urogram is caused by lithiasis, a retrograde pyelogram, if feasible, will often give a fairly exact anatomic index of the potential renal function.

An apparent filling defect in the calices or pelvis of the kidney may be secondary to a diseased condition of organs overlying the kidney. In one case observed, a filling defect (Fig. 1) which was observed in the upper calix of the kidney suggested the possibility of a neoplasm. This supposition was supported by an apparent increase in the size of the renal outline. At operation the kidney was found to be normal and an overlying perforated gall bladder and gall stones were found to account for the apparent renal pain and for the spastic filling defect which was observed in the calix of the kidney. A filling defect caused by actual pressure from an adjacent extrarenal or retro-peritoneal tumor may also be observed in the excretory urogram. Although such defect may persist in the retrograde urogram, it usually will be observed only in the excretory urogram. In one such case observed recently, operation revealed that a large sarcoma of the pancreas was pressing on the kidney.

Clotted blood is a common cause of a filling defect in the renal pelvis or in the ureter. This may be confined to a small portion of the pelvis or ureter, or it may obliterate their lumen entirely. When blood clots become large and organized, and cause persistent urinary obstruction, temporary dilatation of the pelvis and calices may result. Such dilatation usually will disappear following removal of the clot. Blood clots usually will cause an irregular filling defect and the shadow produced by these clots often contains areas of variable density which suggest vacuoles. Such filling defects may be confused easily with those caused by papillary epithelioma of the renal pelvis, which sometimes causes a similar deformity. In order to exclude the possibility that filling defects observed in the urogram might be the result of recent hematuria,

urography should be repeated at the end of a week or two, that is, after the blood clots have had time to disappear. Clots which persist following hematuria caused by lesions such as pyelitis or essential hematuria have been known to cause considerable confusion in diagnosis. Blood clots in the ureter may prevent visualization of the pelvis of the kidney in the excretory urogram (Figs. 2 and 3).

Cicatricial changes in the outline of the pelvis and ureter frequently occur as the result of renal infection. With chronic pyelo-

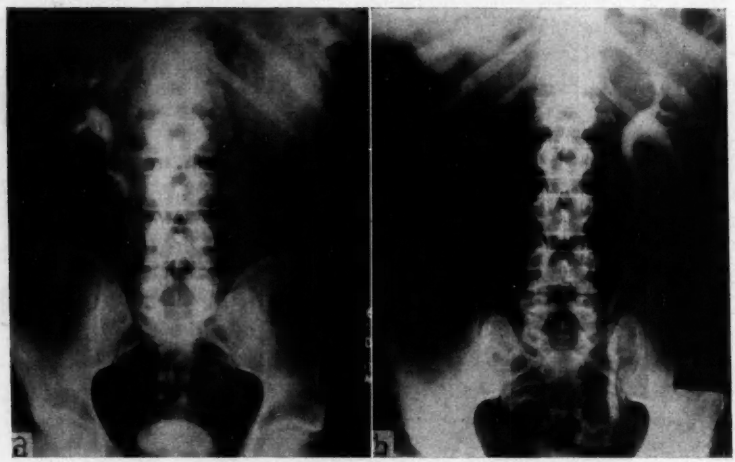

Fig. 2. *a*, No visualization of left pelvis or ureter with excretory urogram. *b*, Normal pelvis in retrogram urogram; absence of visualization may be explained by blood clots which cause filling defects in the lumen of the ureter.

nephritis there are usually regions in which the calices alternately undergo marked contraction and dilatation. In some cases the calices are largely obliterated. Partial or complete obliteration of one or more calices is frequently observed in cases of renal tuberculosis. Similar deformity may be observed following postoperative cicatricial changes.

As a result of ureteral catheterization and injection of fluids into the renal pelvis, a bubble of air sometimes remains, which may cause a shadow suggestive of a filling defect. Air bubbles

in the renal pelvis have been described in cases in which there has not been any previous instrumentation.

An apparent filling defect in the urogram may be caused by overlapping outlines of the major calices in a bifid pelvis. The intervening space between the calices may produce a shadow suggestive of a filling defect. When in doubt in cases of this kind, always make another urogram at a different angle.

Filling defects in the renal pelvis are often observed in cases of renal lithiasis. The urogram is of particular clinical value in

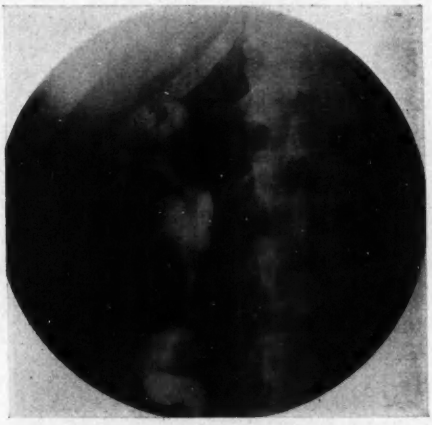

Fig. 3. Filling defect in upper part of ureter, possibly the result of a blood clot.

exact localization of the stone and in the identification of nonopaque renal calculi. When the stone is large, a thin film of medium may be seen in the periphery of the renal pelvis, surrounding the stone, which is marked by an area of comparatively decreased density (Fig. 4). Smaller stones may also cause filling defects in the outline of the pelvis or calix of the kidney. A filling defect at the ureteropelvic juncture that is caused by spasmodic contraction secondary to renal stone is frequently observed in the retrograde urogram and occasionally in the excretory urogram (Fig. 5). The filling defect may be so definite as to suggest stricture of the ureter. In several cases in which this was observed, a meticulous

examination of the upper part of the ureter was made at the time of surgical exploration, but no evidence of ureteral stricture was found. The apparent filling defect will disappear in the postoperative ureterogram.

Filling defects in the outline of the ureter are occasionally observed which are caused by protrusion of tumor tissue from the pelvis or by metastasis. Ureteral involvement by a cortical tumor is unusual but in such cases a filling defect is occasionally observed in the ureter adjacent to the pelvis. This defect is caused by

Fig. 4. Filling defect in renal pelvis, caused by soft stone.

neoplastic tissue which either protrudes into the uretero-pelvic juncture or encircles the involved portion of the ureter. Ureteral metastasis from a tumor of the renal cortex is such a rare cause of a filling defect of the ureter that it usually can be dismissed. Ureteral metastasis secondary to papillary tumor of the renal pelvis, however, is a frequent cause of filling defects in the ureterogram. The defects that are produced by metastasis of this type of tumor may be single or multiple, and may be situated in any

portion of the ureter. It is, of course, necessary in these cases to exclude the possibility that a blood clot may be the cause of the filling defect. Metastasis of minor degree may cause no evidence of a filling defect.

A primary tumor of the ureter usually causes a filling defect and localized narrowing in the ureteral lumen, with a variable degree of pyelo-ureterectasis above or around the tumor. When the tumor is small the deformity may be difficult to recognize. Since visualization of the ureter is often inexact in the excretory urogram, it is

Fig. 5. Spasm at ureteropelvic juncture, caused by stone in renal pelvis.

advisable to make a retrograde urogram in every case in which ureteral neoplasm should be excluded. Ureteritis cystica, when advanced, and granulomas may cause filling defect in the ureteral lumen and may produce a similar deformity. The latter, if large, may be confused easily with neoplasm. Blood clots in the ureter may cause similar confusion. Acute angulation of the ureter as the result of ureterectasis and chronic ureteritis may also cause apparent filling defects in the ureterogram. Passage of bulbous bougies usually will not reveal any actual constriction.

EXCRETORY CYSTOGRAM

Although visualization of the bladder is more or less of a by-product in the excretory urogram, it frequently affords data of

unexpected importance. The amount and density of iodine excreted into the bladder varies among different individuals. It will be sufficient in many cases to visualize any gross defect in the vesical outline. On several occasions filling defects in the excretory cystogram have suggested the presence of neoplasm which was not suspected. In others the extent of the tumor could be inferred better than in any other way. On the other hand, incomplete filling of the bladder may give an erroneous impression of filling defect and other corroboratory data are usually necessary.

Interpretation of apparent filling defects in the urogram after all is largely influenced by clinical and cystoscopic data, and its clinical importance may depend entirely on these factors. That such defects are a valuable finding goes without saying, since they will frequently guide one to the correct diagnosis.

PELVIC PAIN AND SPASM (NEPHRALGIA) DUE TO HYPERACIDITY OF THE URINE

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Nephralgia may be due to a number of causes. Trauma, whether a stone passing down the ureter or a blow upon the loin, causes nephralgia. So does tension within the parenchyma, as in suppurative nephritis. Yet the term "nephralgia" is usually restricted to a spontaneous tenderness of and pain in the kidney, not associated with any gross disease of the organ unless it be slight hydronephrosis. Notable for their absence are infection, stone, reflux, lumbago, et cetera.

This type of nephralgia is often, perhaps always, associated with spasm of the ureter and kidney pelvis due to hyperesthesia of these channels. The spasm is detected by the ureter catheter, the sensitiveness by reproduction of the patient's pain through overdistention by ureter catheter. Blank pyelograms, retrograde or excretory, are not uncommon. We note spasm without nephralgia, perhaps an initial stage of the condition. We have not noted nephralgia without spasm. We recognize, by the way, the inaccuracy of the term nephralgia to describe what is actually uretropyelospasm, but feel that we may safely entrust the philology to others.

Harris and Harris recognize three stages of uretropelvic spasm, the spastic, the dilated and the megalo-ureter. The classification is perhaps more seductive than sound. We have not seen megaloureter result from spasm, only the "hydronephrose minime" of Papin, Legueu and other French authors.

Nephralgia has long been recognized as a symptom and what one might call a refuse heap upon which the careless urologist may cast those cases of lumbar pain he can not diagnose, be they actually due to lesions within the kidney or extraneous to this organ. No wonder the term fell into disrepute and was banished from our vocabulary by more precise methods of diagnosis along with "idiopathic" and other such words. There is a touch of humor in the present occasion for in my father's textbook there was a nice old-fashioned section on nephralgia that dwelt on the importance of

hyperacid urine as a cause. My first revision dropped this. Here is a happy day to make amends.

Even in conservative Europe the term "nephralgia" has tended to disappear from the literature though not from oral tradition. The spas are awake to the irritating quality of hyperacid urine, especially if this contains acicular crystals. It is, by the way, not clear whether the traditional ureteral scratch by crystals actually does or does not cause nephralgia.

I shall not forget the fine scorn with which I listened to Legueu in 1921 describe the cure of a "nephralgie avec hydronephrose minime" by renal sympathectomy. A few years later I was doing the same operation with like success and have desisted only on learning a simpler method of relieving the pain.

Observations made during the past year at the New York Hospital by Dr. Humphreys have reinstated in our minds the notion of pyelo-ureterospasm due to chronic irritation. The only cause Humphreys has found for this irritation is hyperacidity of the urine. Thus we hope for release from surgical incantation in the form of decapsulation (Edebohls), nephrotomy (Rovsing) or ureter dilation (Hunner) all based upon pathologic theories not wholly acceptable to the faculty.

Randall and Muschat have shown that the acidity of the urine, as measured by pH, varies widely and quite suddenly between 6.0 and 7.4. Most people find it extremely difficult to remain on a diet that keeps the pH below 5.5, yet the patient with nephralgia due to urinary hyperacidity runs a fasting pH below 5.5, as witness the following cases:

Case 1.—The patient, a woman twenty-four years old, had pain in her right flank which began three years ago. Exacerbations of pain put her to bed occasionally. Physical examination was negative except for the right flank tenderness. Her abdomen had been explored previously through a low right rectus incision and the appendix and a follicular cyst of the ovary had been removed. This gave no relief from her nephralgia.

The urine, after breakfast, showed no abnormalities except for a pH of 5/6. Pyelograms and cystoscopy showed no evidence of stone or ureteral obstruction but reproduced the pain.

The patient was shown at our weekly conference and sympathectomy was advised. Dr. Humphreys alkalinized her urine, however, and she immediately became symptom-free and has so remained for seven months. Once recently she stopped taking bicarbonate of soda

and the pain returned; she resumed the soda and the pain was relieved.

Case 2.—A man, thirty-eight years old, eight years ago began having intermittent pain in his right costovertebral region radiating to his right groin and testis. The pain, usually dull, at times became severe and colicky. He was brought to the hospital in renal colic, following three weeks of dull pain. The physical examination was not remarkable except for tenderness in the right flank and costovertebral region. This tenderness could not be localized in the kidney, which was impalpable. Pyelography showed no evidence of stone or ureteral obstruction, but reproduced the pain. The urine was clear and acid with a specific gravity of 1018. There was no albumin or sugar. Microscopically, oxalate crystals were found and a very few white blood cells. There were no casts, bacteria or red blood cells. A freshly voided specimen of urine had a pH of 5.4.

The urine was alkalinized with potassium citrate and bicarbonate of soda, and next morning the urine showed a pH of 6.7. No other medication was given, yet he experienced complete relief of pain. In order to test the influence of urinary acidity upon this, the urine was acidified with acid sodium phosphate and acid ash diet. In twelve hours the urinary pH was 5.1 and he complained of severe pain in the right loin, similar to that from which he had suffered on admission. Alkalies were then again administered. The urinary pH was thus restored to 6.8. Oxalate crystals were still found in the urine but the pain subsided progressively as the urinary pH rose. The administration of alkalies has been continued and the patient has remained symptom-free for five months to date.

These two cases are typical of those we have seen.

We have observed that the pH of freshly voided hyperacid urine in these cases is lower than that of a specimen obtained by ureter catheter. This variation is in almost direct proportion to the quantity of blood found in the ureteral specimen. Perhaps this accounts for the temporary relief some patients get from ureteral dilatations.

Symptoms.—The characteristic nephralgic pain, however mild or intense, changes in intensity quite slowly as compared with the abruptness of stone colic. The patient gives a history of pain for years before actual colic occurs. Humphreys has made the interesting observation that when pain is relieved by alkalinization of the urine, reacidification will reproduce pain of like intensity but he has been unable to excite pain by ketogenic diet or drugs in patients who had not previously complained of pain nor has he been

able, by excessive acidification of the urine, to occasion a more severe pain than that which the patient had previously suffered.

The pain radiates down towards the genitalia and is often associated with frequency of urination and bladder pain. The pelvic congestion of menstruation may markedly excite the pain. Artificial menopause will sometimes relieve such pain.

Diagnosis.—When one comes to examine such a patient one may be struck by the sensitiveness of the ureter or by the ureteral spasm that pockets the tip of the catheter in the pelvic ureter. Retrograde pyelography may prove futile because the renal pelvis ejects the fluid as fast as it is injected. Excretory urography may exhibit a like spasm that defeats the examination.

Doubtless, spasm may result from other agencies than hyperacidity though we have not noted this. Spasm without pain perhaps indicates that the hyperacidity has been insufficient in intensity or in duration to cause pain. Our inability to make the patient's accustomed pain worse, no matter how acid the urine, suggests that the irritation must last some time to excite nephralgia. Higgins should have some pertinent observations.

Differential Diagnosis.—There is no chronic pain that is not tainted with neurasthenia of a sort. The fact that most of these patients are women suggests that emotional instability, whether due to endocrine cause or not, enters into the etiology of nephralgia. We have been tempted to use hyperacidity as a test whether the pain is objective or subjective. Twice nephrectomy has failed to relieve the pain of women who had not hyperacid urine. This experience has deterred us from further surgical experiment.

Nerve pain, such as that caused by spinal exostoses, must be diagnosed.

The differential diagnosis of nephralgia from stone, inasmuch as it depends upon the mere absence of the signs of stone or other surgical disease, is perilous. We are liberal in our misgivings that renal pain may be due to stone, even when no stone is found. One should be especially skeptical of pains whose onset is sudden. There is no need to stress this point but we can not resist the temptation to recite a case which for many years was supposed to be one of idiopathic hematuria, due to infection with hemolytic streptococcus and relieved by vaccines!

Case 3.—The patient, a retired stockbroker, fifty-two years of age, was first seen in November, 1928, complaining that for several months he had been passing brownish urine. The urine had been normal in April, 1928, but during November blood had been constantly found. There were no clots, no pain, no discomfort suggestive of the site of bleeding. His previous history was irrelevant. He had never passed stone or suffered pain related to the urinary organs. The blood was from the right kidney.

He came armed with normal retrograde pyelograms and a report of normal kidney function from an excellent urologist. Exploration for tumor was contemplated.

Instead, he was sent to an ingenious medical man who found blood fixation positive to a hemolytic streptococcus of tonsillar origin. An autogenous vaccine was administered and the patient was well in six months. During this illness he suffered no discomfort or pain.

A year later, in 1929, there was a brief, severe, right renal colic. This was relieved by morphine and followed by a negative x-ray.

In 1935 the colic recurred and again required morphine. Urogram findings were negative. No stone passed at any time, to the patient's knowledge.

In 1936 the urine was normal, pH 6.5.

This is stone colic; not nephralgia. The stones have been passed from the bladder silently.

To sum up, the criteria of nephralgia are:

1. There are no pathologic changes other than spasm or atony.
2. When the patient is in pain the urinary pH is lower than 5.5.
3. The pain is relieved by alkalinization and grows distinctly less at a pH of 6.0.
4. The pain may be reproduced by maintaining the urinary pH at 5.0 for about twelve hours.

Treatment.—The pain is controlled by alkalinization with bicarbonate of soda; enormous doses may be required. The pH must be maintained above 6.0. We have found no diet that would accomplish this.

We do not know how to prevent hyperacidity. The relation between nephralgia and gastric hyperacidity has not been established and we have not as yet been able by diet alone to control nephralgia due to hyperacidity of the urine.

Sympathectomy, renal or ureteral, may abolish the pain reflex but the relief thus obtained may not prove permanent. One of our patients relieved of nephralgia by renal sympathectomy returned six months later with recurrence of pain. The pH was then found

to be 4.8. We have greatly ameliorated her pain by alkalinization but have as yet been unable to maintain the pH above 6.0.

NOTE: During the summer of 1936, we got in touch with X. Y., who, because of the relief we gave her, had sent us the patient mentioned in the last paragraph.

X. Y. had begun with pelvic pain which had been imperfectly relieved by laparotomy through a left rectus incision. Then pain in her right kidney pelvis (?) had persisted until the right kidney was removed. Immediately pain recurred on the left side.

We found nothing wrong beyond her various scars. She was exhaustively studied, as many of the staff were doubtful of our ability to cure her by denervation and feared the operation on a single kidney. The pain was repeatedly reproduced by ureteral distention, yet it was felt by the patient rather low and in front, not far from her rectus scar. One of the resident internes maintained that she probably had a piece of omentum pinched in a wee scar hernia.

At operation, therefore, after denervation we excised the rectus scar, finding no hernia. The kidney, too, had appeared normal.

During the eighteen months since operation she has married. She declares herself well and free from pain. Her urine is not hyperacid.

DISCUSSION

DR. BRANSFORD LEWIS (St. Louis, Mo.): I cannot deny anything Dr. Keyes has said, but I do regret that he omitted in his listing of causes for nephralgia, which I take to be simply a term indicating renal pain, one that to me is a very definite and impressive clinical entity that I described on several different occasions in the last six or eight years* and one that has been confirmed by a good many urologists of high standing, namely, "regurgitation renal colic." I first observed this thing in about 1910. It isn't a reflux of urine in dilated ureters, but in normal orifices and ureters under the stress of obstruction at the neck of the bladder, whether organic or spasmodic, whether in men or women, associated with back-pressure, there is produced the same phenomenon of tremendous pain in one or the other kidney. For instance, certain patients have been struck with this pain, have writhed on the floor, have had to get off a train to get morphine, a hypodermic, and in other ways have manifested the intensity of this colic that demanded morphine on many occasions.

It doesn't deserve or demand sympathectomy or any operation directly applied to the kidney because the causation is down at the neck of the bladder. What it does demand is *treatment to relieve the obstruction* produced at the neck of the bladder whether, as I say, from organic or inorganic causes. I won't go into that. Those who are interested in this clinical entity can find it in several different papers under the heading of regurgitation renal colic.* I at first thought it was a nervous reflex, but the research experiments of Graves and Davidoff showed that these regurgitations could occur under comparatively normal conditions, under the stress of pressure, overfilling of the bladder. They demonstrated it over and over again in rabbits and animals, and we have had it demonstrated to us in the human. Not only clinically do we demonstrate this entity but by x-ray. The regurgitation has been shown by x-ray negatives by Dr. McCown and others during the attack. This occurs sufficiently often—I have seen at least fifty cases since

*Bransford Lewis: Urinary regurgitation and renal colic. Jour. Urol., (February) 1926.
Bransford Lewis: Regurgitation renal colic: A clinical entity. Jour. A. M. A., (Feb. 20) 1932.
Bransford Lewis and Grayson Carroll: Further clinical evidences on regurgitation renal colic. Urol. and Cut. Rev., (March) 1934.

1913—to justify equal recognition with the other causes listed by Dr. Keyes. It is almost typical of a stone colic but without the stone.

Dr. Frank Hinman (San Francisco, Calif.): I would like to emphasize the point Dr. Braasch made in the interpretation of excretory urograms to the effect that defects of filling are frequently not true defects, and also the point that very often with excretory urograms—I have seen it two or three times in my own experience—one will see a perfectly good looking pyelogram which on retrograde study shows a definite filling defect. I think those two points should be emphasized in the interpretation of excretory urograms.

Dr. William F. Braasch (Rochester, Minn.): We have been trying recently to find out whether vascular spasticity such as exists with hypertension might be reflected in coincident spasticity of the pelvis and of the ureter. We have made excretory urograms in a series of cases with hypertension to see whether or not there was a spasticity in the outline of the pelvis and the calices. Fragmentary visualization of apparently contracted calices and pelvis is often observed in the excretory urogram. In some of these cases the calices appear small and threadlike, with visualization which is intense in patches. In some of them the outline is seen to be normal in the retrograde pyelogram. However, this is not found to occur uniformly and the excretory urogram was found to be normal as frequently with hypertension as in the average case. The excretory urogram in patients having so-called nephralgia did not show any evidence of spasticity in the few cases in which I have tried it.

Dr. Edward L. Keyes (New York, N. Y.): Dr. Braasch, my remarks, you appreciate, are highly preliminary. Obviously, I did not state that it is improbable that a person having had nephralgia in one kidney and having been denervated or having had the kidney removed, should get nephralgia in the other kidney. We do not yet know the fundamental physiologic basis of this condition at all. I tried to obtain Dr. Higgins' opinion; he refused to discuss the question, but was kind enough to tell me that he has seen no nephralgia from the amount of acidity which he has produced.

Probably nephralgia due to hyperacid urine does not appear until the hyperacidity has existed for a long time. Reflux does, of course, cause gorgeous pain. One expects that pain to appear suddenly, almost like kidney colic, rather than the slow grinding type which the hyperacidity is more likely to cause.

THE INITIATING LESION OF RENAL CALCULUS

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It would be presumptive for me at this time, and before this audience, to tax your time and patience in an exposition of our common knowledge on the origin of renal calculus. We are all equally familiar with the historical background, and we are all equally familiar with the pertinent theories now held as possible etiologic factors: infection; stasis; avitaminosis; colloidal imbalance; hyperparathyroidism. That each of these theories gives us plausible ideas as to how a stone *might* form will be admitted. But medicine, as a whole, demands actual facts, and wishes to know how a stone *does* form; and no research work to date, with which I am familiar, actually tells us how a stone originates, where it starts, how it starts, or why it starts. There seems to be an enormous hiatus in our knowledge between theory on the one hand and frank outspoken facts, as met in the clinic, on the other hand. Likewise, I am certain that many of you have asked yourselves pertinent questions in regard to stone origin which you could not answer, and which the various theories fail to explain: Why does a stone form? Where does it first arise? How does it grow? Why is it for a time stationary? Why is it so often unilateral? And why, when certain theoretic morbid states exist, does it fail to occur? That there is a distinct dearth of knowledge of what I might term the embryonic growth of a stone seems to be outstanding, for nowhere does one find any research which traces from an original lesion the gradually added increment of salt deposit which, in time, accumulates from what must be a microscopic origin to larger and larger size that becomes macroscopic, and develops still further to the point where x-ray detection finds it, or where it makes itself manifest by starting a train of drastic clinical symptoms leading to the operating table.

When one contemplates this picture from these various aspects, or when one asks oneself questions bearing on this period of silent, asymptomatic growth, it becomes almost a foregone con-

clusion that a stone must originate from some form of primary lesion that antedates salt deposition, and during this period of what I have termed its embryonic growth, it must be adherent to some part of the renal pelvic structure and, in such a static condition, grow in silence to what might be called its full term, or maturity. Questions can also be asked for an explanation as to why one man may produce a stone of one chemical composition, and another man produce one of an entirely different salt deposit; which again is a question that no theory today competently explains. It is thoughts such as these, and our inability to answer them satisfactorily, that made me formulate an hypothesis that all renal calculi must have, as a point of origin, some lesion preexisting in the pelvic portion of the kidney. When such a hypothesis is, in its turn, examined as to where such a lesion would, or could, occur, it becomes again a matter of simple deduction that such must have its origin on a renal papilla or the wall of a minor calix. Therefore, in offering an hypothesis for the origin of stone, these two postulates were formulated, and presented the basis for a series of research problems in an effort to prove or disprove their accuracy: first, that an initiating lesion had to exist; second, that any such lesion should be sought for on the renal papillæ, or close thereto. During the past six years seven different research problems have been formulated and tried, in an effort to prove the accuracy of these two postulates, and without troubling you with their details, I might state that they were all directed toward the creation of a lesion on which a renal stone would develop. These experiments were performed on lower animals, and all have failed of their purpose. In our simple line of thought, the initiating lesion which was the easiest to conceive of as existing was an ulceration on a papilla, and, failing in our ability to create such in the lower animals or, if created, consistently to cause renal stone to grow, brought to a close these chapters in our experimental researches.

With this failure of purpose in the production of stone in experimental animals, I next decided to turn to the autopsy table and, by following a large group of autopsies, to hope that I would chance upon lesions of the papilla which, perhaps, could be related to the secondary deposit of urinary salts. To date the kidneys from 104 autopsies have been so examined, and in this work I

have had the coöperation of the pathologists in two hospitals, who have permitted me to have all kidneys before they were even opened. In each and every case the pelvis has been opened first, and with hand lens each minor calix, with its papilla, has been closely examined for evidence of pathologic change. Of this group of 104 autopsies I wish to report that twelve have presented evidences which constitute the material in this preliminary report.

First, let me state that evidences of ulceration and infection have not been found to date. Secondly, one interesting case of a simple cyst of the papilla has been found. Thirdly, we have come upon twelve cases presenting an unusual picture and a new pathologic lesion, which I wish to show you now in a lantern slide demonstration. This picture may be described as follows: On the papilla, generally on its lateral wall, or near its tip, is seen an area, which for lack of a better term, I have called a "milk patch." It may be, in size, anywhere from the tiniest possible dot to an area measuring 2 or 3 mm. in diameter. It may be sharply outlined or delicately stellate in appearance. It may be of uniform consistency, though some have shown centers which appear as though the material forming the "milk patch" is circular in its deposition. In all of the specimens of this character there is every evidence, with naked eye and hand lens, to suggest that what we have seen is under the surface of the covering epithelial cells. This interesting lesion, of course, was subjected to microscopic study. These sections have shown a deposit of calcium, *entirely devoid of any inflammatory evidences,* as being laid down in the wall of the renal papilla and in a position which is, in its earliest manifestation, entirely below the surface of the cells covering the papilla. The renal papilla has neither serous nor mucous membrane covering, but the columnar epithelial cells which line the ducts are continued onto the surface of the papilla as a single layer of flattened epithelium. This surface layer is generally but one or two cells deep. Under it the structures of the papilla are found—blood vessels, lymph spaces, supporting connective tissue and tubules. The pathologic changes of the lesion await the publication of a complete pathologic opinion, but for the time being it seems fair to state that the above described "milk patch" is a deposit of calcium, that the area involved appears to suffer a definite fibrosis, with changes in the blood supply, and that the first deposit of calcium

occurs in the cells lining the tubules, which, in turn, show different stages of aseptic necrosis. If one goes into the depth of the tissue, this process can be seen in its progressive stages, but as one approaches the surface, the deposit of calcium becomes more and more uniform and involves more of the interstitial tissue, until one reaches the surface, where it exists as a definite uniform plaque, bearing a similarity to calcium as deposited elsewhere in morbid processes in the body. Sections have been stained by special methods (von Kossa stain and Erös stain), and this deposit has been proven to be calcium.

The next, or second, stage in a stone's development is exemplified in a kidney removed from the body of a man, forty-six years of age, who died of left pyopneumothorax and cardiac failure. Each papilla in this kidney, with one normal papilla as an exception, showed the characteristic "milk patch" deposit; but on the surface of one such "milk patch" could be seen a tiny black dot. This dot is no larger than a grain of pepper, or a cinder in an eye, but it stands out in clear distinction to the other papillary lesions of the first variety. Serial sections cut through the tiny speck show that the calcium deposited in this area has lost its covering epithelium and exists as a raw, exposed surface of calcium, at whose periphery the epithelium dips down to an aseptic ulcer edge. The black dot itself appears as a secondary covering layer, or deposit, which in the sections appears uniform and of a brown color. Again, no evidence of infection is present.

The next, or third, stage in a stone's development was found in a kidney from the body of a woman, fifty-six years of age, who died of a malignant ovarian tumor and general carcinomatosis. This showed two papillæ with the characteristic "milk patches" thereon and a third papilla with a definite crystal deposit on a similar "milk patch," but in this case the crystal deposit measured approximately 2 mm. in diameter. It was densely adherent to the underlying tissue and, when sectioned, presented a characteristic papillary calcium plaque, and intimately adherent thereto, and growing therefrom, was the large crystalline calculus. The sections from this specimen have been subjected to special staining methods; by von Kossa stain the calculus has been proven to be calcium phosphate, and by Erös stain the plaque again has been proven to be calcium, but not calcium phosphate. Let it here be

noted that on this calcium plaque a secondary deposit of a definitely different chemical character has been formed. Another interesting and instructive observation is seen in a few of the sections cut near the stone's periphery, which show a definite undermining of the edge of the calcium plaque by crystalline deposits and stone's growth. This strongly suggests that as the stone grows, it gradually encases the calcium plaque by undermining its edges, and when the stone breaks free, the plaque is torn from its papillary bed and goes away with the calculus. In this same kidney a similar concretion was found, which, unfortunately, the knife had already broken from its point of attachment. It is of interest that this was probably twice as large as the above described concretion and, on being subjected to a chemical analysis, was likewise found to be composed of calcium phosphate.

A fourth specimen has given us a still further picture in the origin and development of renal calculi. This was found in the body of a man, sixty years of age, seriously injured in an automobile accident, who died of septicemia shortly after admission to the hospital. The superior calix in this kidney intimately encased a typical black mulberry calculus, studded with tiny yellow dots. It was triangular in shape and measured 8x8x6 mm. When its encasing caliceal wall was turned back, it was found to be plastered against the side of its papilla, and the caliceal wall itself was devoid of any evidence of ulceration or infection. Photographed *in situ,* it was then removed, and the portion of the calculus which had been in contact with the papilla was markedly cup-shaped, and the surface of the papilla against which it rested showed an area of soft, sand-like material of a clear yellow color, raised from the surface and measuring 3x6 mm. Sections through this area of this papilla have shown that there is no calcium plaque present, but an eroded surface covered with sandlike particles which take the characteristic von Kossa stain for calcium phosphate. There is no evidence of infection in the microscopic slides of this area. This stone was not adherent and, in fact, floated off its base when being photographed under water. The stone on analysis was calcium oxalate.

At about this stage in the research a patient presented himself with the typical clinical picture of acute right-sided ureteral calculus colic. X-ray demonstrated a stone in the ureter and block-

ing it, being situated about 5 cm. from the uretero-pelvic junction. On this x-ray plate could likewise be recognized the shadow of a smaller stone, measuring 3x4 mm. in size, and unquestionably located in the cup of the minor calix, at the inferior pole of the kidney. This man was operated upon and the stone in the upper ureter removed by a simple ureterolithotomy. It was of a chalky white composition, irregular in outline and, on analysis, composed for the major part of calcium oxalate. A forceps was introduced into the ureterotomy in an effort to reach the second calculus in the lower calix, but as it could not be accomplished, the lower pole of the kidney was excised. The incision passed down through the cortex of the kidney and cut across the lower pole just proximal to the above mentioned stone in the lower minor calix. This specimen, when the calix was opened, showed a stone of a character similar to the other one, measuring but 3x4 mm., lying to the outer side of its individual papilla and adherent thereto. A pressure necrosis was present at the papillary-caliceal angle, which was considered to be secondary to the stone's growth. In handling this specimen, the stone was easily dislodged and fitted into its place as perfectly as a dental inlay. The side of the papilla showed a reddened excavation, or ulcer. Microscopic sections through this point showed no infection. There was considerable engorgement of the blood vessels, and there was every evidence that the original plaque had been torn loose or lifted from its bed with the dislodgment of the stone. This stone, on analysis, has proved to be of the same composition as the one removed from the ureter—calcium oxalate.

It is my thought that as the secondary deposit, or true calculus, grows, crystallization at the edges of the original plaque gradually undermines the plaque and that the calculus, when it gains its freedom, does so by tearing out the plaque from the wall of the papilla. This appears quite definite in the microscopic sections of the last reported case, while, as already mentioned, some of our serial sections through the stone described as the third stage of calculus formation (the calcium phosphate stone above), distinctly show such undermining crystallization. Numerous small calculi that have been obtained from patients after apparent, brief clinical existence consistently show just such a depressed area of what must have been the point of attachment to the initiating lesion,

and constitute one of the strongest leads which clinical evidence has given us in their suggestion of such an initiating lesion. These calculi are being studied particularly with this point in view.

CONCLUSIONS

1. With this preliminary report, I feel that the first postulate has been fulfilled in proving that renal stone originates by growth on an initiating lesion.

2. The second postulate, that such an initiating lesion must be sought for on the renal papilla, I feel has likewise been proven in the microscopic work performed upon the findings above related, for we have been fortunate, in the material available, in finding rather typical progressive steps in the growth of a calculus.

3. There has likewise been described a pathologic process occurring in the wall of the renal papilla, which, hitherto, has not been recognized, and which consists of a sub-surface deposit of calcium.

4. In the series of cases presented we feel that we have traced from this sub-surface deposit of calcium the destruction of its covering surface membrane and the deposit thereon of two characteristic types of urinary salts—calcium phosphate and calcium oxalate. These salts appear to be direct secondary deposits upon this calcium plaque once it is denuded of its epithelial covering.

5. It is our belief that once such a calcium plaque has lost its covering membrane and from then on is bathed in the urinary excretion, on this calcium plaque, as a foreign body, there become deposited certain salts normally present in the urine, and that the salt so deposited follows closely the well recognized laws of the crystallization of salts from any solution wherein seeding for crystallization and supersaturation play the dominant rôles and the determining factors as to the character of salt to be deposited.

6. We do not presume that the above described pathologic stages constitute the sole initiating lesion on which all stones originate, but reserve for further studies the possible relationship of focal infection, ulceration, both septic and aseptic, infarction, allergic mucous membrane reactions, the keratinization from avitaminosis, et cetera.

The author wishes to acknowledge the stimulating and hearty co-operation of Dr. Baldwin Lucke, Professor of Pathology, Dr. O. Norris Smith, Resident Pathologist, and Dr. Perry D. Melvin, Fellow in Urology, of the Hospital of the University of Pennsylvania, and of Dr. John Eiman, Director of the Department of Pathology, Dr. Julius Foldes, Resident Pathologist, and Dr. Edward W. Campbell, Associate Urologist, of the Abington Memorial Hospital.

A PRELIMINARY REPORT ON A STUDY OF THE PROBLEM OF RENAL AND VESICAL CALCULI THAT OCCUR IN THE TRAUMATIC GROUP

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In a paper read before the Section on Urology of the Pennsylvania State Medical Society last October, we recorded our clinical observations on a small group of patients, ten in number, who developed calculi, renal and vesical, following fractures of the lumbar spine, bony pelvis and osteomyelitis. We established, first, that stone formation does occur in this group of patients who are immobilized for long periods, and recited the experience of several observers, including E. H. Paul, who had reported twenty cases of stone formation in gunshot wounds and bony suppuration. In 90 per cent of his cases there were definite evidences of infection on the affected side. He stresses the rôle of infection as a very important, if not the most important, cause of calculi. In all of his cases, the urine was alkaline, infected, the stones of the phosphatic variety.

Hyrntschak of the Wilhelminen Krankenhaus of Vienna, in a paper on the operative treatment of bilateral nephrolithiasis, again stresses the supreme importance of infection as an etiologic factor. He reports fifteen cases. In thirteen cases, the stones on both sides were composed of phosphates; in all, the urine was infected. In three of the cases, there was bony injury and osteomyelitis.

Urostasis, infection and *prolonged immobilization* are given dominant position as the causes of calculus formation.

Joly records two cases of bilateral stones following gunshot wounds of the femur and one case of unilateral stone occurring in a patient with a fractured pelvis.

Sisk, in a paper before this Association, on nephrolithiasis and bone disease, reported five cases. Four of his patients were in hospital at the same time. He records the type of injury, the pathologic changes that took place, the management, chemical composition of the stones, and suggests a plan to prevent stone formation in this group.

His fifth case is extremely interesting; that of a young girl of

thirteen, ill for three and one-half months with a severe coxitis, great destruction of both hip joints, and partial destruction of the ilium, with large stones in both kidneys. Following the institution of appropriate treatment of the bone lesions, with no treatment directed to the urinary tract, there was spontaneous disappearance of the stones and restoration to normal function of both kidneys.

Randall, in a paper on the "Prevention of Recurrence of Renal Calculi," emphasizes the importance of *stasis* and *infection* as outstanding factors in stone formation.

Holmes and Coplan and numerous other observers have reported cases of stone formation following injuries to the lumbar spine.

We submit that the problem of stone formation in the fracture and traumatic group is a practical clinical problem of major importance, and wish to examine it from that angle. It is important for the reason that an increasing number of patients, *stone-free* on admission to hospital, with simple or compound fractures or osteomyelitis, develop calculi during their hospitalization, many with grave damage to one or both kidneys, the latter overshadowing in gravity the lesion for which they were admitted, and from which they might have recovered with little or no functional impairment.

We do not allege a high incidence; the incidence is not high unless a large group is undetected. The number of stone cases occurring in any given group of fractures is small in proportion to the number of fractures.

We do not think this in itself is important. The gravity is the amount of destruction that goes on in this group before they are recognized. In the past we have been asked to see these patients only after they have developed evidence of urinary tract complications.

To illustrate the gravity in our group: One of the patients was admitted with an injury to his fourth and fifth lumbar vertebræ, with very mild and very transient cord symptoms, normal urine, acid in reaction. X-ray was negative for stones and catheterization was necessary for first forty-eight hours. The patient was in bed six months; during that time he developed such extensive bilateral calculi that death occurred from urosepsis. This we regard as a clinical tragedy. Of the remaining nine, three had bilateral stones, removed by pelvio-lithotomy; four unilateral. In three, the destruc-

tion was so great that conservative surgery was not possible, and nephrectomy had to be performed. In one, an unrecognized osteomyelitis of both femurs, extensive calculosis of left kidney, necessitated nephrectomy. The remaining two cases had vesical calculi, removed by cystotomy. There was no mortality in the nine operative cases.

In the ten cases, the complications occurred in six with fractured pelvis, two with fractures of lumbar spine, one with osteomyelitis of femur, one with ruptured bladder and perforation of the rectum. With the exception of a boy with osteomyelitis, who developed an ankylosis of both hips, there was no functional impairment as a result of the primary injury; the only death was due to complications that we feel might have been prevented.

Shortly after reporting these ten cases, we were asked to see two more patients who had developed stones following injury to the lumbar spine, one of which so beautifully illustrates the problem, that we wish to report it in some detail.

CASE REPORT

J. C., aged thirty-five, admitted to the service of Dr. J. W. Robinson, was injured by fall of slate in a coal mine, sustaining a comminuted fracture of the second lumbar vertebra, and associated fracture of the transverse processes of the third lumbar vertebra. X-ray studies were negative for stones, urinary retention requiring catheterization which was continued every eighth hour for four days following admission, when the patient was able again to void normally. The urine at the time of admission was acid in reaction, specific gravity 1020, few epithelial cells, few calcium oxalate crystals. There was no pus or microscopic hematuria that might indicate renal damage at the time of injury. The patient was paralyzed below the level of the umbilicus; he was immobilized in a fracture bed and the necessary treatment for the management of his lumbar injury instituted. According to the records on the chart the urine became alkaline and purulent six days after his admission, and two days following the cessation of catheterization. Six weeks after admission, he had severe attacks of pain in the region of both left and right kidneys, accompanied by fever and chilly sensations. The urine was alkaline and purulent and urination was frequent, and painful. The patient was losing ground rapidly. At this time we were asked to see the patient by reason of the urinary tract complications. X-rays of the tract revealed bilateral renal calculi, multiple, and a bladder almost filled with calculi, varying in size from a bean to a small pea. There were a number of small stones in the right ureter. Spinal fractures were healing.

Laboratory reports were as follows:

N.P.N.	28.5	Blood sugar	92
Urea	7.3	Serum calcium	11.2
Creatinin	1.7	Phosphorus	4.9

Urine culture: B. proteus, B. coli and Staphy. fecalis.

On account of the severe vesical symptoms, and the bladder so filled with stones, cystotomy and suprapubic drainage were decided on. The operation was done under local anesthesia, and an enormous number of stones of varying sizes were removed, the bladder closed around a pezzer catheter.

Immediately before taking the patient to the operating room, further x-ray studies were made and, on examination later in the day, revealed both kidneys and ureters completely free of stones. In the manipulation of the patient, the stones had been rolled out and down the atonic renal pelves and ureters, and into the bladder, where they had been removed. Intravenous urograms revealed dilated renal pelves and ureters.

A neurologic report on the urinary tract at this time is as follows: "The upper level of damage can be placed below the first lumbar, therefore the lumbar enlargement is the seat of considerable trouble. The sacral is not as seriously involved. Sensory loss is less in these areas, and bladder function and tone seem rather good. The ureter and kidney enervation through the sympathetic comes from the twelfth dorsal segment and below this, therefore atony of the ureters should result. If the bladder is less atonic, it can be explained by the fact that the sacral cord is not damaged. (Bladder enervation is generally given as sacral segment 2, 3 and 4.) This is through the autonomic system, but damage in the cord gives the same result because anatomically the sympathetic and autonomic systems are comparable."

If these x-ray studies had not been made at the time of operation deductions as to the efficacy of subsequent treatment would have been entirely misleading. X-ray studies of skull and long bones showed the ordinary amount of absorption that is attendant on confinement to bed. There was no evidence of osteoporosis. Chemical composition of the stones was calcium and magnesium phosphorus with some carbonates.

The patient was put on a most rigid regime: High acid ash diet, two thousand calories with excess of 30 c.c. acid, ammonium chloride, up to 90 grains daily; forced fluids, cod liver oil, twice daily.

The urine remained alkaline throughout the course. The infection persisted, the pH at all times being above six. Repeated x-ray examination gave evidence that stones would form in the kidney, pass down the ureters and be flushed out through the bladder, only to have a recurrence of stones within a period of three to four weeks.

The blood chemistry never rose above 36, the phthalein varied between 25 and 35 per cent. Later on there was an increase in the serum calcium, 14.4, a decrease in the phosphorus, 3.97, and signs of failure of renal concentration, suggesting the renal calcinosis which

Albright has described. In a personal discussion on this particular case, he was more impressed by the infectious side than that of primary parathyroid over-activity. He offered some practical suggestions in the study of this particular problem, especially stressing the dangers of continued use of acidifying drugs, if there is not a reasonably early conversion from the alkaline to the acid side.

In all our cases, we have been impressed by the constancy of certain findings. *Stone-free* on *admission; urine, acid, uninfected;* later *alkaline infected urine usually with urea-splitting organisms; stones, phosphatic in character.* This is nicely illustrated in the case just recited. Bone repair goes on normally in spite of extreme degree of decalcification. The blood calcium figures are rarely elevated. When these patients go over to the alkaline and infected side especially if the infection is B. proteus, they are particularly resistant to all forms of treatment.

Impressed by the gravity of the urinary tract complications that occur in this group, and having opportunities for study of a very large number of traumatic cases (1300 cases of fracture of the femur; 210 cases of fracture of the pelvis; 215 cases of unclassified fractures of the vertebra, have been admitted to one of the surgical divisions in the past twenty years) we have established a Fellowship for the study of this particular group.

Our *major problem* is that of *prevention.* Patients in all fracture cases are seen on admission, and the potential stone formers (simple or compound fractures of the femur, bony pelvis or lumbar spine) are carefully studied as to their status on admission:

The character of the urine.

The bacteriology of the urine.

The pH (this daily).

Jean's test: X-ray of urinary tract and bony skeleton.

Chemical studies consisting of the determination of serum calcium, phosphorus, protein and phosphotase.

In this group rigid measures to prevent the underlying causes of stone formation are put in operation at once.

Stasis.—If immobilized in fracture bed, frequent elevation of renal level is made, by changing position consistent with the treatment of the particular case.

Infection.—Extreme care is used in any instrumentation that may be necessary. This is all done by a member of the Department of Urology.

Elimination of any foci of infection is effected when possible.

Diet.—This group is immediately placed on an acid ash diet with an excess of acid ash from 20 to 30 cubic centimeters, dependent upon the hydrogen ion concentration of the urine. An attempt is made to keep the pH between 5 and 5.2.

Enteric coated pills of ammonium chloride 7.5 grains are given three times daily.

Both dietary measures and medication are carefully controlled by the physician in charge and the dietitian. This we regard as important; both measures are specific as indicated by hydrogen ion concentration.

Fluids are forced; a minimum of three litres per day.

At the same time that the plan for prevention is in operation, this group is being carefully studied as to a possible cause. Why will a certain small group of fracture patients develop renal calculi and others fail to do so? What is the precipitating factor? Investigation along the lines suggested in the studies of Higgins, Randall and Keyser are being continued. The factor of a possible parathyroid overactivity is also being examined.

Particular attention is being paid to the bacteriology of the urine; the determination of the presence of bacteria, the time of their occurrence in relation to the formation of the stones. Do they have a part in the production of the stones, or are they the result of stone formation and stasis? Later, in the event of stone formation, cultures of the stones are made to compare organisms.

CONCLUSIONS

1. Stone formation does occur in stone-free patients who are immobilized for long periods, with fractures of long bones, lumbar spine, bony pelvis and osteomyelitis.

2. It is an important clinical problem, as grave damage may result; in some instances so severe as to result in urosepsis and death.

3. In all cases, the following factors are constant: *Urinary stasis, urinary infection, alkaline urine,* the stones, phosphatic in character.

4. A plan for prevention of stone formation in this group is suggested.

5. A Fellowship has been established at Mercy Hospital, for the study and prevention of stone formation in the traumatic group. The results will be tabulated and reported later.

UROSTEALITHS; DO THEY EXIST?

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The unusual as well as the unexpected is bound to excite interest, and when they occur simultaneously one is inclined to call in friends and relate the experience to them, as much to enjoy their astonishment as to assure himself that he has not been deceived. Such circumstances are responsible for the following report.

The patient whose history I will give in brief was a student nurse, twenty-six years of age, when her medical history began. Upon graduating from training school, she had taken up missionary work in India, but had been returned to the States because of physical disability due to malaria and dysentery contracted in service. In November, 1926, she entered the hospital because of pain and tenderness in the right lower quadrant. A diagnosis of acute appendicitis was made, and an appendectomy performed which was followed by an uneventful convalescence. During the next two years she was a hospital patient on three different occasions for intestinal upsets diagnosed as mucous colitis. In October, 1928, she submitted to a second operation, a right oöphorectomy and diagnostic curettage. The curettage showed chronic interstitial endometritis; the ovary only a corpus luteum cyst. Six months later she was again a hospital patient with a diagnosis of general toxemia associated with an acute pharyngitis. The fall of the same year her name appeared on the orthopedic service where she was treated for right sciatic pain by manipulation, but the following spring found her again under investigation for right-sided pain. *A complete cystoscopic examination was made at this time.* Pyelograms showed a slightly enlarged right kidney with moderate ptosis. The urologist did not feel that the urinary tract was responsible for her complaints, which, however, were so persistent and unusual that an abdominal exploration was made, and the left ovary removed. Her convalescence this time was very stormy. It was necessary to open the wound at the end of two weeks to free adhesions, but the pathologic examination of the ovary revealed only a simple cyst.

In the fall of the same year she was again in the hospital, at which time a second cystoscopic examination was made with essentially the same findings. The case was referred to the orthopedic service and a plaster jacket applied. When the patient was thirty years of age, a fourth laparotomy was performed for the freeing of adhesions. A few months later she returned to the hospital with severe acute abdom-

inal pain. This time the surgeon noticed the pain was entirely contrary to any known symptom-complex, and a neurologic consultation was sought which proved negative. Six months later, the pain persisting, a fifth abdominal exploration was made through an entirely new incision. The following June, a cholecystectomy for cholecystitis was performed. This seems to be the only positive pathology that had so far been found, but it did not relieve her symptoms and a sixth laparotomy was done in June, 1933, for the freeing of adhesions. Four months later the cholecystitis wound was excised and the fistulous tract resected. No relief of symptoms having resulted from all

Fig. 1. Calculi diagnosed as urostealiths.

this surgery, an extensive gastro-intestinal study was carried out, the findings of which are inconclusive. The following year she was again a patient on the orthopedic service because of sacro-iliac strain. A manipulation was performed, and a spica cast applied.

I first saw the patient during the convalescence from this last surgical procedure, when she was complaining of intense pain in the right side. Her right kidney was not palpable. Tenderness could be elicited on deep palpation in the right lower quadrant, and there was considerable tenderness at the costovertebral angle. The x-ray was negative and a pyelogram was essentially the same as the one made three years before. A diagnosis of ureteral calculus opaque to the x-ray was entertained, and multiple catheters left in the ureter for forty-eight hours with the idea of dilating the ureter in the hope of removing the stone, or stones. Upon withdrawal of the catheters the patient experienced a most severe colic and passed several stone fragments. This was followed by a period of relief from symptoms, to be followed again by further colic and the passage of more stone fragments. A week later she was again examined cystoscopically under anesthesia, and a Council stone extractor passed up and down the ureter with no obstruction being felt. Four hours

later the patient had a severe colic and passed four stone fragments. Relief of pain, however, was not complete unless opiates were used, so the following day four catheters were passed up the ureter and left in place. Relief of pain was then complete, but upon their removal the following day, the previous symptoms returned and two of the catheters had to be replaced in order to control the paroxysms of pain.

In the meantime, the pathologic department had examined the specimens of stone and returned a report on December 7, 1934, which was as follows: "Specimen consist of a crushed stone which was apparently about 3 mm. across. The external surface is gray and markedly spiculated. Microscopic: On chemical examination the stone is found to burn completely at a low temperature and sputters much like fat. It promptly goes into solution in ether and on evaporation of the ether, bundles of needle-like crytals typical of fatty acids are found. It is not soluble in ammonia as is cystine, and no ammonia odor evolved on addition of NaOH, in which the stone was insoluble. It is likewise insoluble in nitric acid and sodium hydroxide. Chloroform dissolved it promptly. On heating small particles on a slide, a globule was formed of each particle, which on cooling showed in its substance needle-like crystals. Diagnosis of urostealith. There is a possibility of a minute amount of calcium on the surface but the inner portion is soft."

Urostealiths are a rare type of stone. These were the first ones I had ever encountered and I hastened to have them photographed.

Keyser and Braasch, in their paper on the "Etiology of Urinary Lithiasis," write, "Fatty stones (urostealiths) have been occasionally described. Their source and chemical composition are veiled in obscurity. We have found little literature on the subject. Horbaczewski analyzed one such specimen and found protein, fatty acids, and neutral fats to be the chief constituents." Joly, in his book, *Calculous Diseases of the Urinary Organs,* writes as follows: "As far as I am aware, concretions of this curious substance have only been found in the bladder. It is a soft, waxy, or fatty material which hardens on exposure to the air. It is almost completely soluble in ether and benzine, melts on being warmed, and leaves a greasy streak on paper. Its nature and origin are unknown."

The statement that concretions of this curious substance have only been found in the bladder is incorrect, for Thévenot, in the *French Journal of Urology,* under the title "Renal Lithiasis of an Exceptional Nature," reports renal calculi invisible to the radiograph which do not ferment and whose cellular elements do not

degenerate and are not mineral crystals but are soluble in ether and contain but little carbonate or phosphate. He classifies these stones, because of their chemical reaction, as urostealiths.

MacCarty also reports an autopsy examination of a woman in whom he found eleven soft concretions in the left hydronephrotic kidney and a single calculus of the same consistency in the right renal pelvis. It is noteworthy that the patient, when admitted to the hospital, was in a moribund condition resulting from a most extensive pelvic malignancy which had extended through the sacrosciatic foramina and involved all the soft structure round the left hip. So extensive was this growth that the left ureter was obliterated in the process, and the vesical involvement may be imagined.

MacCarty also reports similar specimens of renal calculi in the museum of the Royal College of Surgeons (number 78 in the catalog).

A careful examination of the literature at the American College of Surgeons Library reveals only these three cases.

The extreme rarity of urostealiths made me very cautious as to my findings. I sent some of the stones to the pathologic department of a second hospital, and in a few days received the following report: "The specimen is two small stones from the kidney. Powder from the stones burns with a continuous pale yellow flame. It is soluble in both ether and alcohol. A trace of uric acid is present by the murexide test. A tract of calcium carbonate is also present. Diagnosis, urostealith." Interesting as these reports were, I still had the problem of ridding my patient of her symptoms, and as the x-ray of her urinary tract showed some very indefinite but highly suspicious shadows in the right renal area, I decided to use ether as a lavage in the right kidney pelvis to see if these shadows would disappear. When ether was dropped on a fragment of the stones the patient passed, it immediately dissolved; and, upon evaporation, left multiple sheaths of crystal on the microscope slide.

At the next cystoscopic examination, I injected 10 c.c. of ether into the kidney pelvis, not in the belief that I should dissolve all the stones, but to ascertain if it had any deleterious effect. None was demonstrable, and forty-eight hours later I again irrigated the pelvis with ether, this time with 100 c.c., allowing the ether to remain in the pelvis until it boiled and the distention was uncomfortable. The withdrawn ether was saved and evaporated, but no fatty acid crystals appeared in the concentrate. I might add also that no untoward symptoms ever developed as a result of the lavage.

The absence of any evidence of fat in the concentrate made me

very suspicious, and my doubts were not lessened by the fact that, in spite of the many cystoscopic examinations and ureteral manipulations, there had never occurred any febrile reaction or increase in pulse rate. Also difficult of explanation was the fact that I had never found any stones in the bladder or ureter, although the patient had passed many. However, there was insufficient evidence to warrant a charge of malingering or to chance an accusation with the hope of a confession, so I continued to treat the case as if it were one of renal colic until I should obtain more calculi.

While waiting to obtain more specimens, I searched the literature and found that the term, urostealith, was first used by Dr. F. Heller in 1845 to describe a number of small concretions passed by a man twenty-four years of age who was suffering with symptoms of bladder stone. He reported that, when fresh, these stones were soft and elastic, but upon drying became brittle and waxlike. They dissolved readily in ether, and in alcohol with some difficulty. In hot water they softened but did not dissolve. They burned with a bright yellow flame and contained a large number of earthy phosphates. Dr. Heller's observations were confirmed by Dr. More, of Dublin, who examined specimens of this curious substance which he received from Dr. Adams, of Dublin, and Dr. Little, of Sligo, and reported in the *Dublin Quarterly Journal of Medical Sciences* for May, 1854, with keen Irish intuition, as follows: "I have had two or three specimens of solid fatty matter sent me, which were stated to have been passed in the urine, but the evidence was not conclusive. It was not certain in one case if the pellets of fat passed along the urethra at all; and in the others it was not proved that they were not passed up in the first instance."

In 1870, L. S. Beale, in his book *Urinary Deposits and Calculous Disorders, Their Nature and Treatment,* writes, "It is hardly credible what trouble some patients will take to deceive us; very often deception is practiced and carried on for a long time without detection. From not being able to discover any reasonable motive, we are sometimes too ready to conclude that our suspicions are unfounded; and thus we may be led to believe statements which are really false, and report cases apparently of very exceptional character, which only prove that the greatest ingenuity has been employed for the mere purpose of imposing upon us." From the above quotation, it is apparent that as early as 1870 considerable

skepticism existed as to the genuineness of urostealiths. The most famous specimens then in existence were in the Huntarian collection in the Museum of the College of Surgeons in London. In a catalog of urinary calculi published in 1842 they are figured and described, with the following remark concerning their origin, "On account of some real or supposed disease of the bladder, a solution of soap has been injected into its cavity. Mutual decomposition between the soap and the salts of the urine has been the necessary result; the alkali of the former uniting with, and forming soluble compounds with, the phosphoric and other acids of the urines, while the earthy bases of the urine have precipitated, in combination with the fatty acids of the soap, in the form of a semi-gelatinous sparingly soluble compound, being in fact an earthy soap; this substance, acting as a foreign body in the bladder, has induced the deposition of the phosphates, and given rise to the formation of a calculus."

In more recent times we find H. Gideon Wells, in his *Chemical Pathology,* writing as follows: "Urostealith calculi, composed of fatty matter, have been occasionally observed. Although some of the concretions described under this head have really represented foreign bodies introduced through the urethra (e.g., Kruckenberg's concretion of paraffin from a bougie), yet true fat concretions do occur. The origin of the fat in these stealiths is unknown, possibly it comes from degenerated epithelium. Horbaczewski (Zeit. physiol. Chem., 18:335, 1894) analyzed such a specimen which had the following percentage composition:

Water	2.5
Inorganic matter	0.8
Organic matter, chiefly protein	11.7
Fatty acids	51.5
Neutral fat	33.5
Cholesterol	traces

The fatty acids consisted of stearic, palmitic, and probably myristic acid."

In 1916, Schahl reviewed the world literature up to that time and reported a urostealith that had developed from lard which the patient has used as a urethral lubricant. He writes, "The calculi under discussion develop in either of two ways: (1) They are formed from substances foreign to the body and introduced from the outside through the urethra into the bladder; (2) they develop from fatty substances created within the human organism." This

second manner of origin is assumed in only two of the known cases, and in one of them it is doubtful.

That up until 1916 but one authentic case could be found, and that since then no others had been reported, made me extremely skeptical about my own case.

I discussed the condition at the Southwest Medical Association meeting this spring, and Dr. Lynch of El Paso informed me that he had a patient who passed urostealiths and would be glad to send me the specimens. Upon having them examined, I received the following report: "A yellowish-brown stone about 3 mm. in diameter, crushed easily and burned completely with a brief yellow flame. No odor, no residue. This stone did not prove to be soluble in any of the materials usually used in the analysis of stones. Not soluble in ether, $ChCl_3$, alcohol, potassium hydroxide, ammonia, acetic acid or hydrochloric acid. The murexide test for uric acid was negative. Cholesterol reaction was negative. This stone is organic matter but due to the small size further analysis is impossible. No crystals were made. A red transparent stone, so hard it became necessary to use a hammer to crush it, was insoluble in all the materials named above. The benzidine test for occult blood was done, which was negative. The stone burned completely with a sudden yellow flame. No residue was left. Due to its hardness no crystals could be made. A stone about 3 mm. in diameter of greyish color was found to be very hard. Crushed only with the use of a hammer. The stone was opaque. It did not burn and the analysis showed it to be composed of calcium carbonate. One stone 2 mm. showed both calcium carbonate and organic material. It burned with a yellow flame and left a grey residue soluble in HCl with discharge of gas."

Obviously his case was one of that group to which Braasch referred when he wrote, "To the various types of urinary calculi which are usually described in the literature should be added a form of lithiasis or rather pseudolithiasis which is not generally recognized and which from its nature may well be termed *hysterical lithiasis.*"

Human urine being free of fat except in cases of cysturia usually associated with filaria, it is evident that urostealiths can form only if some degenerative process (malignant or inflammatory) occurs sufficiently extensive to result in sloughing with the lib-

eration of oily material in the urine. MacCarty's case was evidently of this type, the oily products of the degenerated tumor having reached the renal pelves by reflux up the ureters.

That the vast majority of cases of urostealiths are reported as being found in the bladder is not surprising. Soap being the result of the chemical action of a base and a fatty acid, the alkaline urine acts quite naturally on oils that are introduced for therapeutic reasons or as lubricants. Gaulier, in reporting such a case of vesical calculus, calls attention to the fact that fatty stones may also form around drops of acid as around any foreign body whatever, in which case saponification does not occur, but the mass originates as an emulsion incorporating other elements of the urine inducing phosphates, desquamated epithelial cells, et cetera. In Hinman's recent book he dismisses the subject with the following terse statement: "Urostealiths, or oleocalculi, are related to fatty acids and fats, or to oils such as gomenol, which have been introduced and are very rare."

Still doubting that my specimens could be urostealiths in spite of the reports of two competent pathologists, I sent the next specimens which I obtained to the Department of Chemistry of the University of California and to Dr. Osterberg at the Mayo Clinic. Both reported that the fat content of the stones was largely cholesterol and that the stones had undoubtedly originated in a gall bladder.

The next time the patient presented herself at the office in acute pain demanding further relief by ureteral drainage, upon separating the labia, multiple fragments of stony material were seen to be adherent to both lips, quite evidently smeared there in an endeavor to thrust them into the bladder. The diagnosis of urostealith was of course changed to that of hysterical lithiasis.

The question has remained in my mind, may not the other recorded cases in literature be of similar nature? And, as Beale suggested, may not the reporting physicians have been led to believe statements which were really false, and to have reported cases apparently of a very exceptional character?

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DISCUSSION

DR. CHARLES C. HIGGINS (Cleveland, Ohio): I am certain that we have all enjoyed the contribution of Dr. Randall. It is extremely difficult to prove or disprove the various theories that have been expounded on the etiologic factors associated with calculous disease, especially in the experimental laboratory.

If we review the theories of our physiochemists on the precipitation, protective mechanism of the colloids, guttulate precipitation, and other theoretical factors, it is extremely difficult to verify these statements.

There is, however, evidence which demonstrates conclusively that calculous disease may be produced in the experimental laboratory. Rosenow and Meisser demonstrated a specificity of streptococci, and in our experimental laboratory, we have shown the relationship between urinary calculi and a deficiency in vitamin A in the diet. At the present time in the experimental laboratory, we can produce in the white rat, stones composed of calcium phosphate with traces of carbonate. Modification of the diet by decreasing the phosphorus in relation to calcium, produces stones composed of carbonates with traces of phosphate, and in chickens we can produce calculi composed of uric acid. In the dog, stones composed of calcium ammonium phosphate and in the Dalmatian dog, calculi composed of uric acid have been caused to form.

Two factors are essential for stone formation: (1) the presence of a colloid and (2) the presence of a crystalloid. Precipitation of the urinary salts ordinarily leads to formation of sediment and not to formation of a calculus; therefore, a colloid must be present. What is the initiating factor responsible for the production of these colloids? I have thought with Dr. Randall that there must be a lesion in the kidney which is a source of the colloid which in turn binds together the crystalloids being precipitated in the urine.

The characteristic structure of a calculus depends entirely on the pH of the urine. With a pH above 6.9, which is the point at which phosphates are first precipitated, the calculus may be composed of alkaline salts; below 5.2, calculi will be composed of salts that are precipitated in acid urine. During the last year, Mr. Kovach,

my laboratory assistant, and I have studied the range of precipitation of all urinary salts. We have found that at a pH level of 6.9 there is initial precipitation of phosphates and at approximately 7.1 there is preciptation of carbonates. Below 6.9 these salts are maintained in complete solution and are not available for formation of calculus. At a pH level of from 5.4 to 5.6, we have initial precipitation of oxalates; at 4.9 precipitation of uric acid first occurs. The precipitation curves in patients with urinary calculi are identical with those in noncalculous disease. These facts are extremely important, especially in determining the postoperative regimen to prevent the formation of calculus.

In the management of recurrent stones which usually form in an alkaline urine and are composed of phosphates, the pH of the urine must be reduced to 6.9 to maintain these salts in complete solution. This is done by use of the acid-ash diet. Care must be exercised, however, that the pH is not reduced to a point at which precipitation of urates and oxalates will be possible or the stone may be formed with these chemical constituents.

We have also been interested in trying to determine why calculi occur so frequently following operation. Therefore, for the past several months, at the time I have removed a stone from the pelvis of the kidney by pelviolithotomy, I have also removed a portion of the kidney pelvis directly contiguous to the stone. In the majority of cases, the epithelial surface of the mucosa is entirely gone, ulceration is present which may be superficial or extend down to the muscularis layer, and round cell infiltration is present. Likewise, in a large number of these cases, a deposit of salts has been found on the ulcerating surface, the chemical constituents of this deposit depending entirely on the pH level of the urine. If this is above 6.9 this deposit will be of alkaline salts and if below 5.2 it will be of acid salts.

Therefore, in this group of patients, especially those with the recurrent calculi, I think the initiating factor is the occurrence of a lesion on the mucosal surface of the kidney pelvis approximating the calculus. Similar lesions can be produced by infection, avitaminosis, trauma, or any destructive lesion that erodes the surface of the mucous membrane. Infection is not essential to the formation of calculi; however, it is of considerable importance not only to note the presence of any organisms but also to deter-

mine whether or not they have the property of splitting urea. I do feel that by the use of the dietary regimen, in addition to other therapeutic procedures, and by giving special attention to the pH of the urine, we can minimize the incidence of the recurrent formation of renal lithiasis.

A similar routine may be utilized in the treatment of orthopedic patients required to remain in the recumbent position for a long period of time. Another point of extreme importance was mentioned by Dr. Braasch at the meeting of the American Medical Association. He emphasized the value of frequent change in position of the patient if possible.

It is only by correlation of all the known facts concerning the etiology and treatment of urinary calculi that we can hope to solve this problem.

Dr. Hugh Cabot (Rochester, Minn.): I want particularly to address myself to Dr. Randall's paper, because, subject of course to confirmation, it seems to me likely to prove one of the outstanding contributions of our generation. The problem of calculus formation has always been the problem of the nucleus. We have spent too much time, I think, concerning ourselves with the constituents of the calculus after it has come to full size. It is the nucleus that has been the key to the situation. We have been shown the basis of development here, and the work of Dr. Higgins enables us to carry it further. In other words, a great variety of causes may lead to the tissue change which Dr. Randall showed, but, given that tissue change, the stage is set for calculus formation. Some of the profound mysteries are at least suggestively cleared up here. It seems to me it is a very important contribution.

Dr. Leon Herman (Philadelphia, Pa.): I would like to take this occasion to congratulate Dr. Randall on this magnificent presentation. He and I have often discussed this matter together and he was good enough to show me some of his slides before they were presented here. It would seem more than a coincidence that these deposits to which he refers occur in the apices of the papilla of the kidney. They are submucous in position, and apparently aseptic in origin, and when one speculates

on their derivation he would seem to be limited to two hypotheses, namely, that they are either hematogenous or possibly result from the excretion of salts by way of the tubules. We have an instance of calcifying papillitis in which the entire apex of one papilla had been eroded. This was a case of such severe hematuria that nephrectomy was necessary to save the patient's life. This eroded area was salt encrusted and the question arose whether the calcareous infiltration was primary or secondary. It seems entirely possible that this is an advanced condition of the type described by Dr. Randall.

Microliths in the urinary tubules were not uncommon, and I have seen instances in which the entire tubular system was littered with these deposits. It is conceivable that they might penetrate the walls of the excretory tubules and in this way assume a submuscosal position. I have also seen complete calcification of the apex of a papilla, the calcifying mass resting on an intact minor calyx, and it would seem that the initiating lesion in this instance was salt deposition in the tubules.

Again permit me to congratulate most heartily Dr. Randall for his fine presentation, and to express the hope that additional observation will permit us to discover the fundamental cause of the condition.

Dr. Vincent J. O'Conor (Chicago, Ill.): For practical value Dr. McCague's remarks concerning the problem of stone formation in cases with fracture and osteomyelitis cannot be overemphasized. Because of my association in the departments which are handling a large number of traumatic cases, I have been interested in this subject for a number of years. About five years ago I made an effort to establish some routine prophylactic measures in the case of hospital patients with fracture and osteomyelitis. Since most of these patients persistently ran a neutral or alkaline urine, and since the stones which were removed in these cases were without exception of calcium phosphate and calcium carbonate, we felt that routine acidulation of the urine might prevent the precipitation of urinary salts sufficient to create a stone. Following the work of Dr. Higgins and recognizing the fact that the hydrogen ion determinations must be made on the freshly voided urine, we have established a routine which is carried out by the nurse

who tabulates the colorimetric pH determinations on a chart simultaneously with the removal of the urine specimen from the patient's bed. A recent paper, "nitrazene," which is very cheap and has no other drawback than the personal error of color detection by the eye, has aided us recently in this work.

Generalization is always dangerous and this has been proven true in these instances. We were sure that acid ash diet and acidulation would prove the routine method of preventing stone formation in these cases, but we actually produced uric acid stones of considerable size in two fracture patients who apparently were normally running to an acid ash. In order to avoid this error we now watch the pH of the urine during the first ten or 14 days of the patient's hospitalization and if the patient consistently runs urine of pH 5.5 or lower we do not try to acidulate the urine further. If, however, the urine is uninfected and more or less alkaline for a period of a week we place them on a liberal acid ash diet with forced vitamin A substances and acidulation of the urine with ammonium nitrate.

What the mechanism of stone formation associated with fracture and osteomyelitis may be, we have not as yet any definite etiologic evidence. None of our patients has shown an elevated blood calcium and none has suggested hyperparathydroidism. I believe a contribution such as Dr. McCague has made here this morning should stimulate all of us to attempt a more intimate coöperation with the surgeon and orthopedist in an effort to utilize our latest knowledge concerning the prophylactic measures for renal stones.

Dr. Frank Hinman (San Francisco, Calif.): It seems to me that the Association has received entirely too casually this very wonderful demonstration of Dr. Randall so beautifully presented. It explains very clearly and beautifully the mechanism of formation of stone, probably not the mechanism of formation of all stones but certainly of the majority of stones.

When one looks at this specimen which hasn't been passed around, one is astounded at the fact the pathologists have not seen these lesions on the papillæ of these kidneys. They are perfectly obvious to us now when they have been demonstrated by Dr. Randall. Of course, the explanation is obvious. The pathologist

takes a kidney and puts it in the palm of his hand with the pelvis down and takes his long autopsy knife and sections the kidney, takes a block from the parenchyma, and he absolutely ignores the calix and papillæ and the pelvis of the kidney all these years.

I wish to congratulate Dr. Randall on this demonstration. It shows that discoveries are not made accidentally, that most of them have an idea back of them. He has had this idea and slept with it for six years and he has now demonstrated it very beautifully as a fact.

DR. WILLIAM E. LOWER (Cleveland, Ohio): I also cannot refrain from discussing this paper and expressing my personal appreciation of this very excellent symposium which has been presented and especially to thank the Program Committee for planning it.

The two difficult problems in urology today are stone and malignancy and it seems to me that the former is coming nearer to a solution. We are beginning to bombard this atom as the physicists do and see what is on the inside, and I think that if the various clinics will just keep at it with the encouragement they have, it won't be so very long until we will know the real cause of urinary lithiasis. So far, Dr. Randall has carried this up to the point of the circulation. Now, if we get a little more light from the other side, probably we will understand the entire mechanism of the formation of stones, and, with that knowledge, will find a way of preventing their occurrence. That will be a great day for humanity and a great achievement for the urologist.

DR. ALEXANDER RANDALL (Philadelphia, Pa.): I suppose you all could realize not only our surprise but our embarrassment when we began finding an unknown lesion. The question which immediately arose in our minds was, what is it and why was it? I think the discussion has led us directly, as Dr. Lower has said, to the realization we ought to have come to long ago: Stone in the upper urinary tract is a symptom and its cause is essentially a prerenal one.

With regard to the material which we have been watching, it still is awaiting a great deal of investigation. H. G. Wells, in

his Harvian lecture on calcification and ossification, points out that wherever calcium is deposited in the body, whether it be in the making of bone or in the deposition of simple calcium or calcification as we call it, it is always deposited in one form, approximately 86 per cent calcium phosphate and 14 per cent calcium carbonate. Now, to differentiate this material by stain has been difficult, but I am perfectly free to say that we have made differentiating stains. I unfortunately could not bring a slide with me which shows that this plaque is probably calcium carbonate and calcium phosphate in the regular rule by which it is usually laid down. Now, if that is true, then you go immediately to a reason for calcium deposition, and there we find written across the whole human body that where cell death occurs, which may be for various reasons and in various progressive stages, calcification follows.

The pathology of this condition has got to be written by a pathologist. We are working on it.

I think I can tell what is in the paper, that as far as we can go today there is the occurrence of the death of lining cells of the connecting tubules. The cause of this death we are not prepared to say. But with death of tubule cells, in their place ordinary calcification occurs and from then on probably for the same reason it progresses, and, as in the pictures shown to you, it loses its epithelial covering to be bathed by urine with secondary deposition of urinary salts.

We have been a little troubled in trying to correlate this finding with the so-called calcium infarction; similar to the uric acid infarction in infancy, calcium infarction has always been assumed to be an intratubular deposit of calcium salts, generally amorphous. Our lesion is different—and there is no reference to it anywhere in the literature that we have been able to find.

I think we have been thorough. In the recent two-volume book by Lubarsh on the pathology of the kidney (part of his enormous system of pathology beautifully written), he says that the original thought was Henle's, that salts in renal infarction, *i.e.*, calcium infarction, occur in the tubules, but both he and a man working in his laboratory have shown that calcium deposit (he again uses the word infarction) can occur extratubularly. With that one exception we have not been able to find any reference to

the subject in the literature on the pathologic changes of the kidney. Also Lubarsh does not comment in any way at all on the possible relationship of such interstitial tissue calcium deposit to the formation of stone.

The pathologic study of the renal papilla has yet to be written, for it seems to have been completely neglected for the interest in parenchymal disease, and the same can be said in regard to the physiology of the collecting tubules. It has been a great pleasure to save the presentation of this research for the meeting of this Association, whose discussion and approval I prize more highly than that of any other audience.

CLINICAL DATA ON HYDRONEPHROSIS IN INFANCY AND CHILDHOOD

A REPORT OF 101 CASES

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There seems to be reason to assume that as more and more attention is directed toward the study of the urinary tract in infants and children our knowledge of this particular field in urology will be greatly enhanced and, as a result, much information will be obtained regarding the nature, incidence, and extent of the various urologic lesions of infancy and childhood. With this information at hand there will naturally result a better and more widespread understanding of the subject and this will undoubtedly benefit the patient in regard to early diagnosis and treatment. It is needless to emphasize at this time that early diagnosis and early treatment are imperative in renal surgery if irreparable damage to the kidney is to be prevented (Fig. 1).

Recent studies verify the statements made by various authors, in this as well as in other countries, that renal tuberculosis in children is rare.[3] Furthermore, the general impression that urinary stones in children are relatively uncommon in this country likewise seems to be confirmed by the experience of urologists and pediatricians.[4] As time goes on, more and more information will be obtained concerning these lesions, as well as other lesions of the urinary tract in children, so that more will be known and understood in regard to early symptoms, thus making possible early diagnosis and treatment.

Pyelonephritis (acute or chronic) is probably the most common condition that occurs in the urinary tract in children. While it is true that a large number of these cases clear up either spontaneously or with medical management, it is important nevertheless to bear the fact in mind that the clinical picture of pyelonephritis often masks other serious lesions of the kidney, such as stone, tuberculosis, or hydronephrosis.

In my own experience the cases of hydronephrosis that have

come under observation far outnumber the cases of stone, tumor, or tuberculosis. I fully realize that this is my experience and that it may not tally with the experience of others.

This paper is based upon a study of 101 cases from the Presbyterian Hospital, Children's Memorial Hospital, and from the

Fig. 1. Destruction of the kidney due to hydronephrotic atrophy.

records of private patients. Cases of hydronephrosis associated with tuberculosis are not included.

AGE

The youngest patient in this series was a boy three and one-half weeks old who had a double kidney and a double ureter. There was a marked hydronephrosis of the upper half of the kidney as well as a marked dilatation of the ureter. There were fifteen pa-

tients under one year of age and twenty-five patients under two years of age, an incidence of 24.7 per cent before the age of two years.

Attention should be called to the large number of cases that occurred before the second year. No cases were included over thirteen years of age; there were fourteen patients between the ages of eleven and thirteen years, five of whom were thirteen.

TABLE I. AGE

Under 6 months	9 cases
6 months to 1 year	6 cases
1 year to 2 years	10 cases
2½ years to 4 years	15 cases
5 years to 7 years	28 cases
8 years to 10 years	18 cases
11 years to 13 years	14 cases
Not stated	1 case

SEX

A review of these cases showed but a slight difference as to sex—there were fifty-two males and forty-nine females. Among the fifty-two boys there were 16 cases in which obstructing lesions were found at or in front of the neck of the bladder, a group of lesions that *does not occur in girls.* If we deduct these sixteen cases, the relationship changes slightly in favor of girls, so that we now have forty-nine girls and thirty-six boys. The foregoing group of cases associated with obstruction will be discussed further on in this paper.

SIDES INVOLVED

A review of these cases shows but little difference with reference to the frequency with which the right and left side was affected by the hydronephrosis, since there were thirty-one cases of right-sided hydronephrosis and thirty cases of left-sided hydronephrosis. Further study, however, showed that there was bilateral involvement in forty cases, that is in almost 40 per cent of the cases.

TABLE NO. II.—SIDES INVOLVED

Right side	31 cases	30.6%
Left side	30 cases	29.7%
Bilateral	40 cases	39.6%

HYDRONEPHROSIS ASSOCIATED WITH OBSTRUCTIONS AT OR IN FRONT OF THE BLADDER NECK

There were sixteen cases of hydronephrosis in this group. The primary consideration was the diagnosis of the nature and location of the obstructions. It goes without saying that the treatment for this group of cases of hydronephrosis must be directed toward the relief of the obstruction.

There were nine patients who had congenital valves in the prostatic urethra. One of the interesting facts about this group of patients was that they were admitted at a much earlier period of life than were the rest of the patients in this group, and furthermore they showed much more extensive hydronephrosis than did the rest of the group.

In the remaining cases the obstruction was due to bars, contractures, and strictures of the urethra. Table III contains the various obstructive lesions found in this group of cases:

TABLE III. BLADDER-NECK OBSTRUCTIONS

Congenital valves	9 cases
Stricture of urethra	3 cases
Median bar	2 cases
Contracted bladder-neck	2 cases

As an illustration of a very extensive bilateral hydronephrosis due to congenital valves in the posterior urethra, I should like to present the following case:

Case 1.—Congenital Valves in the Posterior Urethra with Associated Hydronephrosis.

G. T., male, aged eight months, was admitted to the Children's Memorial Hospital on August 7, 1935. Complaints on admission to the hospital were difficulty of urination, cloudy urine and frequency.

Three months prior to admission to the hospital the mother noticed that the child would cry every hour, at which time he would strain and pass some cloudy urine which apparently relieved him.

Physical examination revealed a pale, thin, colored baby appearing very ill. The child was drowsy. The head, neck, heart, and lungs were negative. Examination of the genitalia resulted in negative findings. Examination of the abdomen revealed a suprapubic tumor that extended one fingerbreadth above the umbilicus and was tense but not painful.

Blood count on admission showed red blood cells, 4,730,000; white blood cells, 12,650; hemoglobin 62 per cent.

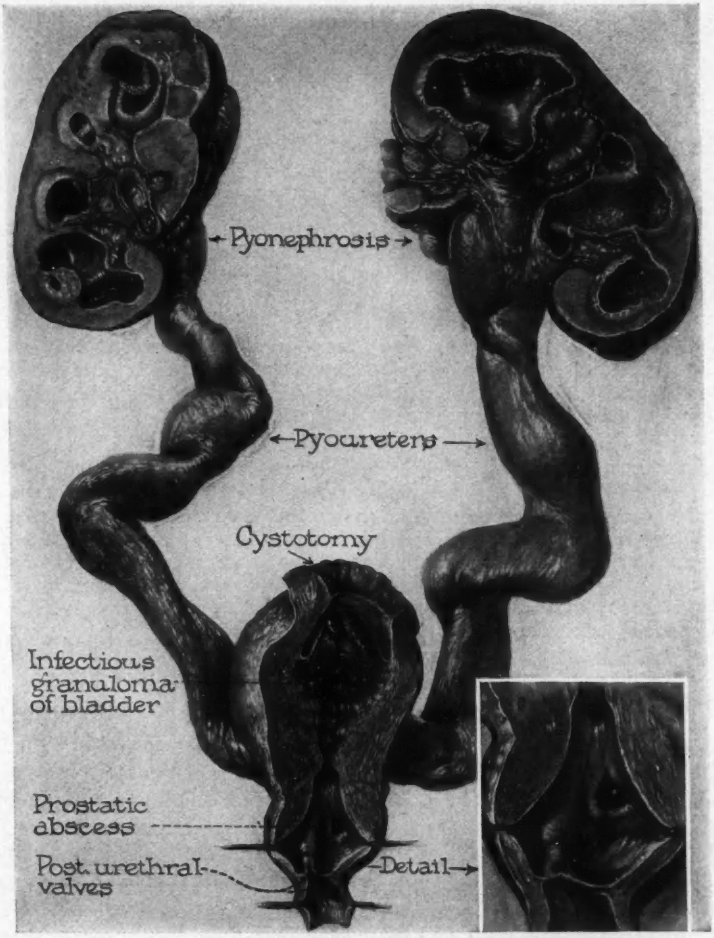

Fig. 2. Case 1. The presence of an enormous, infected hydronephrosis and hydro-ureter and thickening of the bladder wall due to the presence of congenital valves in the posterior urethra. Insert shows the opening of an abscess in the prostate.

Urinalysis on admission showed a trace of albumin, 18 to 20 leukocytes, and red blood cells.

Blood chemistry on admission showed nonprotein-nitrogen 47.1 and creatinin 1.5.

Roentgen-ray examination was negative for stone in the urinary tract.

Intravenous pyelograms were made on August 13, September 13 and November 11, 1935; no visualization of pelves, ureters, or bladder.

Phenolsulphonephthalein test showed an output of 10 per cent of dye in 90 minutes and a total of 30 per cent in 150 minutes.

Operation.—A suprapubic cystostomy was done on September 19, 1935. The bladder wall showed an enormous hypertrophy, the mucous membrane was red, and exploration of the internal urethral orifice was negative.

Following the operation the child had a very stormy convalescence and many recurring attacks of pyelonephritis so that at no time was the child in a condition that justified relieving the obstruction due to the presence of valves in the urethra (Fig. 2). The child died on April 8, 1936, seven months after the cystostomy.

The *anatomic diagnosis* is as follows: Congenital valves in the posterior urethra; hypertrophy of the bladder wall; severe cystitis; infectious granuloma of the bladder mucosa at the site of the suprapubic catheter; bilateral dilatation of the ureters; marked bilateral pyo-ureters and bilateral infected hydronephrosis; disseminated abscesses of both kidneys; left epididymitis; abscesses of the prostate gland; enlargement of the retroperitoneal and periaortic lymph nodes; hypertrophy of the left ventricle of the heart; extreme malnutrition; secondary anemia.

CYSTIC DILATATION OF THE URETER AND HYDRONEPHROSIS

Although cystic dilatation of the ureter as a cause of hydronephrosis is rare, there were three cases in this series in which this etiologic factor was present. Two of the patients were girls and one was a boy. The dilatation occurred on the right side in two cases and on the left in one case. The boy had an obstruction at the bladder-neck due to a bar, and in one of the girls the condition was associated with a double ureter. These patients were from three to six years of age.

FOREIGN BODY IN THE BLADDER AND HYDRONEPHROSIS

In one of our cases the patient developed complete retention following an acute febrile disease, the nature of which was not determined. A tentative diagnosis of acute poliomyelitis had been made.

The boy developed complete retention of urine so that it was necessary to catheterize him (the catheterization was done elsewhere). When the catheter was withdrawn from the bladder it was noted that a large piece of the catheter was broken off and remained in the bladder and he was referred to the Children's Memorial Hospital. The presence of the catheter was visualized by roentgen-ray and a set of intravenous pyelograms was made which showed the presence of a slight bilateral hydronephrosis that disappeared after the catheter was removed.

LESIONS OUTSIDE THE URINARY TRACT ASSOCIATED WITH HYDRONEPHROSIS

It is a well-recognized fact that pressure on the ureter from without may result in the production of hydronephrosis. In the adult this is seen in certain lesions of the internal genitalia in women. Because of the rare occurrence of these lesions in childhood, this type of hydronephrosis is very rare. In this series no such case was encountered. On the other hand, there were two cases in which lesions outside the urinary tract were associated with hydronephrosis.

In the following case it is perfectly obvious that the pathologic changes in the pelvis were a factor in the production of the hydronephrosis.

Case 2.—Hydronephrosis Associated with a Pelvic Abscess.

S. T., male, aged five and one-half years, was admitted to the Children's Memorial Hospital on October 4, 1935. The present illness began two and one-half weeks prior to admission, with fever and painful urination. It was necessary to void about every twenty minutes and the act was associated with great pain. Several days later pain and soreness developed in the left lower quadrant of the abdomen.

Physical examination.—The head, neck, heart, and lungs were negative. Examination of the abdomen revealed a palpable mass in the lower left quadrant, apparently taking its origin in the pelvis, and extending about 1.5 inches above the margin of the bony pelvis. Rectal examination showed a mass in the left side of the pelvis which corresponded with the abdominal mass described above.

The day following admission the patient passed a large amount of pus per rectum. Following the rupture of the abscess into the rectum there was a rapid diminution in the abdominal tenderness, the swelling subsided, and the temperature became normal.

Examination of urine on admission showed albumin, 2+, many white blood cells, no red blood cells, and no casts. Urine culture showed Staphylococcus aureus.

Blood count showed 3,700,000 red blood cells, 39,500 white blood cells, and 60 per cent hemoglobin.

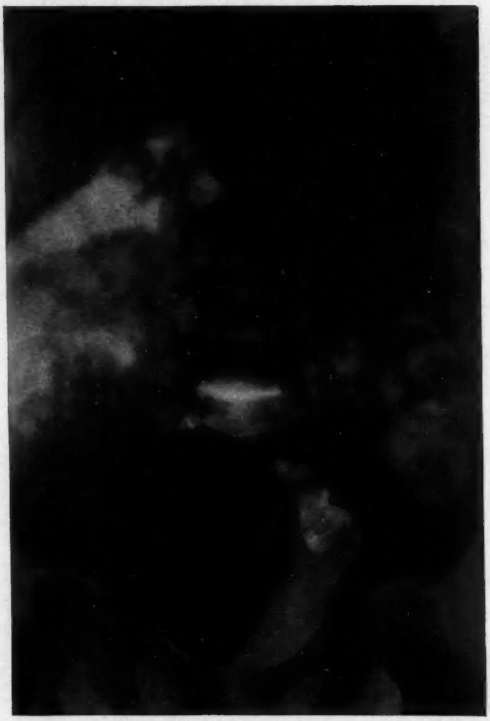

Fig. 3. Roentgenogram showing a left sided hydronephrosis and hydro-ureter due to a pelvic abscess. Note the filling defect in the cystogram.

Roentgen-ray examination was negative for stone in the urinary tract. There was no evidence of bone disease such as osteomyelitis.

Intravenous pyelogram revealed the right side to be normal, with a marked hydronephrosis and hydroureter on the left side (Fig. 3).

Cystogram showed an incomplete filling of the bladder, as though the bladder was compressed by a mass within the bony pelvis (Fig. 3).

In the other case the hydronephrosis was probably an associated finding, since the patient had a tumor of the round ligament of the liver.

Case 3.—Hydronephrosis Associated with a Tumor of the Round Ligament of the Liver.

Fig. 4. Roentgenogram showing the outline of the calcified cyst and a right hydronephrosis.

C. D., female, aged six years, was admitted to the Children's Memorial Hospital on October 31, 1935, because of an enlargement of the abdomen.

Physical Examination.—The head, neck, heart, and lungs were normal. The abdomen was atonic, flabby, and relaxed; the umbilicus was displaced to the left of the midline. The left flank bulged laterally and superficial veins were prominent. A large, firm, freely movable tumor, the size of an orange, was found in the right half of the abdomen.

Roentgen-ray examination showed an almost spherical density 8.4 by 7.4 cm. in diameter, in the right upper quadrant, superimposed

upon the lateral halves of the eleventh and twelfth ribs. The circumference was made up of a ring of slightly greater density, suggesting that the density was due to a deposit of opaque material (calcification) about a tumor mass most likely made up of fluid or semisolid material (Fig. 4). The transverse diameters of the lumbar vertebræ increased very rapidly from above downward, and there was slight incomplete fusion of the lamina of the fifth lumbar vertebra and rather broad transverse processes to this vertebra, which were not sacralized.

Intravenous pyelogram showed a right hydronephrosis (Fig. 4).

Examination of the urine on admission showed no albumin, 2 to 4 white blood cells, and was negative on benzidin test.

Blood count showed 4,200,000 red blood cells, 10,000 white blood cells, and hemoglobin 80 per cent.

On November 2, 1935, the patient was operated on by Dr. Montgomery, who removed a tumor from the round ligament of the liver. The histologic diagnosis was calcified congenital cyst of the round ligament of the liver.

Subsequent intravenous pyelograms showed that the hydronephrosis was still present, hence was not affected by the removal of the cyst.

STONE IN THE URINARY TRACT ASSOCIATED WITH HYDRONEPHROSIS

The association of stone in the kidney and ureter with hydronephrosis is common knowledge although attention may be called again to the fact that patients with relatively large stones in the kidney do not necessarily have associated hydronephrosis. In this groups of cases the following incidence of stone in the kidney and ureter in association with hydronephrosis was found:

TABLE IV.—STONE ASSOCIATED WITH HYDRONEPHROSIS

Kidney stones	2 cases
Kidney and ureter stones	2 cases
Kidney, ureter, and bladder stones	1 case
Ureter stones	3 cases
Total	8 cases

Undoubtedly the incidence of hydronephrosis and stone would have been much larger had either retrograde pyelograms or intravenous pyelograms been made in many of the early cases of stone in the kidney and ureter. I have called attention to this fact in a previous publication.[4]

HYDRONEPHROSIS ASSOCIATED WITH LESIONS OF THE CENTRAL NERVOUS SYSTEM

Lesions of the central nervous system in association with hydronephrosis occurred in four cases. Attention has been called by Mertz and Hamer to the importance of spina bifida from the urologic point of view. Although hydronephrosis associated with

Fig. 5. Bilateral hydronephrosis following ureteral transplantation into the bowel.

lesions of the central nervous system is rare, both in adults and children, it is important nevertheless, because of the possibility of this association, to bear it in mind since it may have an influence on the treatment outlined for the patient.

In this series hydronephrosis was associated with lesions of the central nervous system in four cases, three of them being cases of spina bifida and the other a case of poliomyelitis.

HYDRONEPHROSIS FOLLOWING URETERAL TRANSPLANTATION

In two of the patients in this series, ectopic bladders had been relieved by bilateral ureteral transplantation, one by myself and one elsewhere, and subsequent intravenous pyelograms showed the presence of a slight hydronephrosis in each case (Fig. 5).

THE PRESENCE OF CONGENITAL ANOMALIES OF THE KIDNEY AND URETER WITH ASSOCIATED HYDRONEPHROSIS

Before the days of modern urologic diagnosis, renal anomalies were thought to be rare, and for all practical purposes were the subject of autopsy reports only. As more and more patients were subjected to careful urologic study, it soon became apparent that renal anomalies occur much more frequently than had been supposed. The same statement can be made regarding renal anomalies in childhood. And finally, since the advent and more frequent use of intravenous urography many more congenital anomalies are found both in adults and children. An interesting paper dealing with the frequency of congenital anomalies found at autopsy in children was recently published by Bigler.[2]

The fact that a kidney which is the seat of congenital anomalies is more apt to become the seat of pathologic changes than a normal kidney is well recognized. Therefore, it was extremely interesting to study this group of cases from that point of view. However, in two of our cases the congenital anomaly occurred on one side and the hydronephrosis on the other.

In this series the following developmental kidney and ureteral anomalies were found:

TABLE V.—CONGENITAL ANOMALIES

	Cases
Double kidney and ureter	5
Double kidney (right) and bifid pelvis (left)	1
Double kidney and ureter (left), bifid pelvis (right)	1
Bilateral double kidney and ureter	1
Solitary double kidney	1
Double kidney and ureter with cystic dilatation of the vesical end of the ureter	1
Double kidney and ureter with opening of the accessory ureter below the external urethral orifice	1
Bifid pelvis	1
Bilateral bifid pelvis	1
Bifid pelvis with cystic dilatation of the vesical end of the ureter	1
Solitary kidney	1

Incomplete rotation of kidney	2
Congenital dystopia of kidney with aberrant artery	1
Aberrant artery	1
Bipolar blood supply	1
Renal infantilism	2
Congenital cystic kidney	1
Cystic dilatation of vesical end of ureter	1
Total	24

In other words, renal anomalies were found in twenty-four cases, or 23.7 per cent.

SYMPTOMS

There is no typical symptom-complex of hydronephrosis. The symptoms may at times be due to the underlying pathologic condition that is responsible for the development of the hydronephrosis, such as stone, or obstruction at or below the neck of the bladder. Occasionally the hydronephrosis runs an apparently silent course and is discovered only on routine urologic examination.

1. In my experience the largest number of patients presented themselves with a clinical picture of acute or chronic pyelonephritis. In many of the patients, although the hydronephrosis was relatively large, attention had not been called to the urinary tract until after the onset of infection. In many of the patients a history of recurring attacks of pyelonephritis and the presence of a chronic pyuria following one or more attacks of acute pyelonephritis led to a complete study of the urinary tract which demonstrated the presence of hydronephrosis. It is because of this fact that all children who have a history of recurring attacks of pyelonephritis, or in whom the pyuria following an attack of acute pyelitis does not clear up, should be subjected to a complete examination of the urinary tract to determine the reason for the so-called chronic pyuria. The largest number of cases that form the basis of this paper fall into this group. It was interesting to note the frequency with which the infection of the urinary tract followed an infection in the nose, throat, and sinuses, or followed in the wake of one of the acute infectious diseases.

2. *Tumor.* In some of the patients the first indication of hydronephrosis was an abdominal tumor—that is, the mother of the child noticed a gradually increasing size or swelling of the abdomen, which generally was painless. According to the mother's observation, the size of the abdomen may seem to vary, appearing larger

at one time than at another. Although in this series of cases the number of patients admitted to the hospital because of an abdominal tumor was small, I should like to report one of the cases in which the size of the hydronephrosis was the largest I have ever seen in a child. It occupied the entire left half of the abdomen and reached to the nipple line on the right side (Fig. 6). Due to

Fig. 6. Darkened area shows the enormous size of the hydronephrosis.

the enormous size of some of these hydronephroses one is inclined to believe that they have been present for a long time. The case I am about to report, however, is that of a patient of only seven months of age and the swelling of the abdomen was noted at the age of two months.

Case 4.—Large Silent Hydronephrosis.

G. D., male, aged seven months, was admitted to the Children's Memorial Hospital on May 25, 1936.

The mother had first noticed a swelling of the baby's abdomen when he was two months of age. This had been particularly noticeable when the child would sit up and the mother believed that the swelling

had become progressively larger. There were no urinary symptoms. Enemas had had no effect on the size of the abdominal swelling. The mother had noted that the abdomen was enlarged and "stuck out" on the left side. She was of the opinion that during the last three months the enlargement had progressed very rapidly.

Physical examination revealed a well developed, well nourished child,

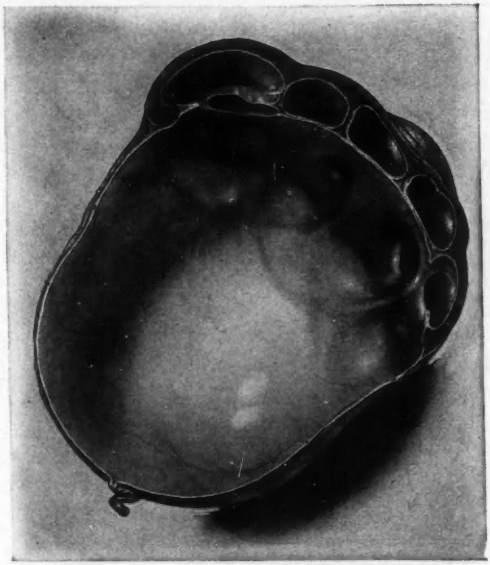

Fig. 7. Drawing showing the kink in the ureter and the presence of an enormous hydronephrosis.

apparently not acutely ill. Eyes, ears, nose, throat, lungs, and heart were normal. On examination of the abdomen a mass was felt in the left side which apparently originated from under the costal arch and extended downward below the left anterior spine. In the midline it extended almost to the symphysis pubis and on the right to the nipple line. The mass was neither painful nor tender and the impression derived was that it was soft (Fig. 6).

Urinalysis on admission was negative for albumin, blood, and pus.

Blood count showed 4,500,000 red blood cells, 21,250 white blood cells, and 75 per cent hemoglobin.

Blood chemistry showed non-protein nitrogen 35.4, urea nitrogen 14.8.

Roentgen-ray examination was negative for stone. A large soft tissue shadow was seen.

Intravenous pyelogram showed a normal pyelogram on the right side. There was no visualization on the left side.

Operation consisted of a left nephrectomy. A large hydronephrotic kidney was removed (Fig. 7).

3. In the group of cases in which the hydronephrosis is due to obstruction at or in front of the bladder-neck, the clinical picture is that of vesical-neck obstruction. Difficulty in urination, straining, a small weak stream, dribbling, and suprapubic tumor make the diagnosis relatively simple. When infection occurs, the clinical picture of acute pyelonephritis is superimposed upon or added to the bladder symptoms.

As has already been mentioned, the general symptoms, in a very large number of cases, completely dominate the clinical picture, hence the urinary pathologic condition is not only overshadowed but overlooked by the attending physician, with the result that often when the patient is admitted to the hospital irreparable damage has already been done to one or both kidneys. Nevertheless, urinary changes can be readily ascertained if repeated examinations of the urine are carried out.

In Table VI is given a list of the symptoms presented by the patients (101) who formed the basis of this paper.

TABLE VI.—SYMPTOMS

Fever	67 cases
Pain	54 cases
Pyuria or cloudy urine	54 cases
Nausea or vomiting	45 cases
Frequency	40 cases
Pain on urination	25 cases
Incontinence	20 cases
Nocturia	20 cases
Chills	20 cases
Gastro-intestinal upset	18 cases
Poor appetite	18 cases
Hematuria	16 cases
Burning on urination	16 cases
Enuresis	16 cases
Difficulty	16 cases
Headaches	16 cases
Loss of weight	15 cases
Dribbling	9 cases
Urgency	7 cases
Irritability	4 cases

DIAGNOSIS

If the possibility of hydronephrosis is borne in mind in those cases in which a child presents a history of recurring attacks of pyelitis or in cases of persistent pyuria which fails to respond to medical management accurately carried out, the proper diagnosis could be made more frequently than it has been in the past and at a much earlier period in the course of the disease.

Fig. 8. Showing a large soft parts shadow due to hydronephrosis that extends from the arch of the ribs into the iliac fossa. Note the complete displacement of the intestines to the right.

A history of rapid enlargement of the abdomen should be given due consideration and also of great importance is the mother's observation that the tumor has varied in size from time to time. A long-standing history of symptoms compatible with obstruction at or in front of the bladder-neck should always arouse our suspicions of the possibility of hydronephrosis being present.

The physical examination in cases with a small hydronephrosis is negative. On the other hand, physical examination may show

the presence of a large swelling in the renal area. This may or may not be associated with pain or tenderness. A palpable kidney or a mass in the kidney region was found in twenty-two cases.

Roentgen-ray examination should be carried out in each patient. This may or may not show an enlargement of the kidney. In one of our cases the outline of hydronephrosis was demonstrable in the

Fig. 9. Intravenous pyelogram showing visualization of only the upper half of a double kidney. Compare with Figure 10.

plain roentgen-ray film (Fig. 8). Roentgen-ray, outside of showing changes in the kidney outline and stones when present, does not furnish one with much diagnostic information.

The intravenous pyelogram probably has its greatest field of usefulness in this group of urological conditions. Great care, however, must be exercised in the interpretation of the films, and it is needless to emphasize that, when doubt arises, a retrograde pyelogram is always in order. Failure of the dye to visualize the kidney must be interpreted with the greatest care. An interesting exam-

ple of this is the pyelogram of a patient in which the upper half of a double kidney (Fig. 9) visualized and was normal although there was no visualization of the larger lower half, due to the fact that the lower and larger half of the kidney had undergone complete hydronephrotic atrophy; the embryonic upper half was normal. The diagnosis in this case was verified by a retrograde pyelogram (Fig. 10).

The cystoscopic examination, except in the cases of bladder-neck obstruction, adds nothing to the diagnosis. However, cystoscopic examination and ureteral catheterization for evidence of pathologic change as well as for the demonstration of function, normal or otherwise, on the other side must be done before surgical intervention is carried out.

The statement has been made many times that the patient suffering from hydronephrosis often has a normal urine; it is because of this fact that the condition is overlooked for a long period of time, so that irreparable damage to the kidney has already occurred when the patient comes under observation. While hydronephrosis may occur in a patient with normal urine with relative frequency in the adult, and while this statement has been made with relative frequency concerning children, such has not been my experience. It may be that the patients in this group may have presented a different clinical picture than the patients in another group. However, in the study of these 101 cases from the point of view of urinary findings, it was exceedingly interesting to note that pus, at one time or another, was found in 97.8 per cent of the urines examined. In other words, in approximately 98 per cent of these patients either pus was present in the urine when the patient came under observation or pus had been found by the physician before the patient came in to the hospital. An analogous statement may be made for the presence of other abnormal elements. The next most common element was albumin and this was noted in 68 per cent. Table VII gives the results of urinalysis for the series:

TABLE VII.—URINALYSIS

Pus	97.8%
Albumin	68.8%
Red blood cells	47.3%
Gross blood	30.1%
Casts	17.2%
Normal urine	2.1%

BACTERIOLOGY

In some of the early cases no bacteriologic studies were carried out, and in others no records of bacteriologic studies are at hand—whereas in another group of patients, seen in consultation, the referring physician had not carried out cultural studies of the urine.

A review of the cases in which bacteriologic studies were made shows that colon bacilli, either alone or in association with other organisms, were found in 48.6 per cent of the cases. The various types of organisms found are given in Table VIII:

TABLE VIII.—BACTERIOLOGY

B. coli	48.6%
Staphylococcus albus	27.3%
Staphylococcus aureus	9.5%
Streptococci	9.5%
B. pyocyaneus	6.8%
Eberthella	2.7%
Gram-negative bacilli	2.7%
Diplococcus bacillus	2.7%
B. proteus	1.3%
B. alkal	1.3%
Streptococcus viridans	1.3%
Pyogenes albus	1.3%
Enterococcus	1.3%
Sterile	17.8%

DIFFERENTIAL DIAGNOSIS

Of great importance in the differential diagnosis is the determination of underlying factors or symptoms that make for the presence of hydronephrosis. This includes, in the first instance, a determination of the infravesical and supravesical causes of hydronephrosis.

Of the various lesions of the kidney that call for differential diagnosis are acute and chronic pyelonephritis, tuberculosis, stone, and tumor.

Hydronephrosis may, at times, be confused with other retroperitoneal lesions, and since some of the cases present gastro-intestinal symptoms, lesions of the gastro-intestinal tract must be borne in mind in this particular group of cases.

That hydronephrosis by its size may be confused with gastro-intestinal conditions because of its effects was illustrated in one of our patients in whom the gastro-intestinal examination showed displacement and a filling defect in the colon (Fig. 11).

PROGNOSIS

My experience with the subject of hydronephrosis in infancy has impressed me with the fact that a large number of patients have come under observation late in the course of the disease—that is, at a time when far-advanced destruction of the kidney had occurred. There seems to be several reasons for this, foremost of which is the failure on the part of the attending physician to inter-

Fig. 10. Retrograde pyelogram showing large hydronephrosis that failed to visualize in the intravenous pyelogram. Compare with Figure 9.

pret the sequence of events and the failure of clinical diagnosis, so that when many of these patients are seen by the urologist there is already a complete or almost complete destruction of the kidney and only a nephrectomy can be offered to the patient. On the other hand, in some of the early cases, in whom the patient was seen early in the course of the disease and the contributing factor removed, the results were brilliant.

TREATMENT

The treatment depends upon the underlying contributing factors. The cases of obstruction at or in front of the bladder-neck call for suitable correction, namely dilatation of strictures of the urethra, destruction of congenital valves, either by means of fulguration through the urethroscope or surgery, relief of bladder-neck obstruction with the resectoscope or open surgery.

Fig. 11. Note the filling defect and displacement of the colon due to the hydronephrosis.

The group of cases in which the condition is due to stricture at the vesical end of the ureter require repeated dilatation by means of the cystoscope and ureteral catheter followed by pelvic lavage, which has proved emminently satisfactory in a large number of cases.

Attention should be called at this time to the small group of

cases in which this form of treatment was followed by severe infection of the kidney. In one instance an immediate nephrectomy was necessary to save the life of the patient. This patient had a stricture not only in the vesical end of the ureter but also at the ureteropelvic junction.

When a stricture is present at the ureteropelvic junction asso-

Fig. 12. Roentgenogram showing an enormous destruction of the kidney following plastic operation upon the ureteropelvic junction.

ciated with infection the treatment is indwelling ureteral catheter, dilatation, and pelvic lavage, before resorting to surgery.

The surgical treatment may best be discussed under conservative surgical measures, and radical surgery. Conservative operation carried out in this group of cases consisted of plastic operation at the ureteropelvic junction. Included were the division of an aberrant artery, nephro-ureterolysis, and the various plastic operations, such as excision of the stricture and implantation of the

ureter into the kidney pelvis. As previously mentioned, in the past a large number of these patients came in with far-advanced disease so that the only possible procedure was nephrectomy.

Of the number of patients operated upon, nephrectomy was carried out in eighteen cases. In one of the patients upon whom a plastic operation was done, the operation failed to relieve the

Fig. 13. Roentgenogram showing constriction in the pelvic portion of the left ureter with dilatation above. The constriction was due to a firm fibrous band. The band was divided by open surgery.

symptoms. Following the operation the patient ran a very stormy convalescence and became very septic, so that it was necessary to remove the kidney ten days after plastic operation on the kidney pelvis (Fig. 12).

In one of the cases the hydronephrosis was due to compression of the ureter by a very thick fibrous band (Fig. 13). The ureter

was exposed extraperitoneally and the fibrous band divided and excised.

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OBSERVATIONS ON HYDRONEPHROSIS WITH SPECIAL REFERENCE TO ABERRANT VESSELS

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Let me first of all say how deeply I appreciate the honor which has been done to me in inviting me to address such an important body of urologists as the American Association of Genito-Urinary Surgeons.

It is only right for me to inform you that I received your kind invitation at very short notice, when I was already fully occupied in preparing another important address; may I therefore crave your indulgence for any shortcomings which I am afraid may be in evidence in this presentation?

I wish principally to deal with the relationship between hydronephrosis and obstruction to the ureter by a blood vessel. In bringing up this matter may I ask your forbearance once again—this time for resuscitating a topic about which I wrote at considerable length at one time in the past.† My excuse for the repetition is that the subject is of academic rather than practical interest and consequently has slipped somewhat into the background.

Some years ago I set out to gather what information I could on the relationship of the so-called aberrant renal vessels to hydronephrosis. The way I proceeded was to visit as many as possible of the important Pathological Museums in London and to hunt out all available specimens of hydronephrosis which showed the ureter being compressed by a blood vessel, and in which the artery or vein concerned remained unsevered from its parent trunk. I found, in all, twelve specimens. Through the kindness of the different Museum authorities I was allowed to collect them all together, and thus was enabled to study them carefully. It soon became obvious that in them all the compression of the ureter by the blood vessel was but a complication of a pre-existing hydronephrosis, and moreover that more often than not the vessel con-

†Brit. Jour. Surg., 13:50; 247-281, 1925.

cerned was not an aberrant one at all, and always one or other, or both, of the arterial or venous channels connected with the lower pole of the kidney. These vessels, as you know, enter or leave the lower part of the renal hilum in front of the lower part of the renal pelvis. Let me remind you with an illustration which vessels I am talking about.

Figure 1 is a drawing of a post-mortem kidney. It is a left

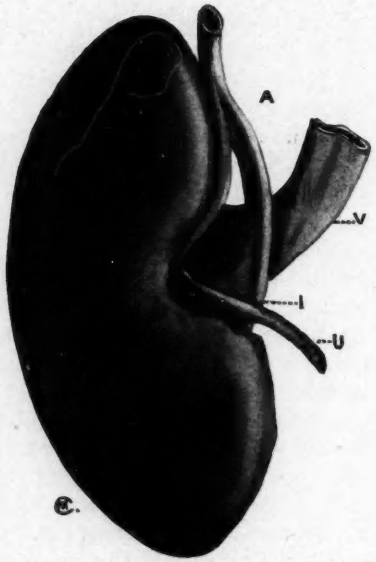


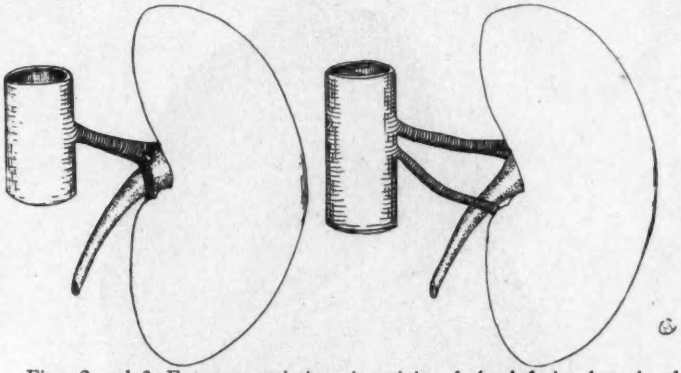
Fig. 1. *A*—artery; *V*—vein; *I*—inferior branch of renal artery; *U*—ureter.

one and we are looking at it from behind. The artery marked I is the inferior branch of the renal artery and we notice that it enters the lower part of the hilum in front of the lower part of the pelvis. I want you to notice the considerable interval which exists between the superior and inferior branches of the renal artery.

Now let me explain to you by means of further illustrations how the mechanism of the vascular obstruction occurs.

Before doing so we must agree that a pelvic type of hydro-

nephrosis can occur without the help of an obstructing blood vessel. At this stage it will be useful to look at some diagrams showing the front of the renal pelvis and the renal artery with its principal branches (Figs. 2 and 3). Should the renal pelvis begin to dilate, it would tend to bulge forward more than in any other direction as this is the line of least resistance, and it would moreover pass above the normal inferior branch of the



Figs. 2 and 3. Extreme variations in origin of the inferior branch of the renal artery.

renal artery, provided there is sufficient space between this and the branches to the upper part of the kidney.

It must be obvious that it is only a question of degree of distention before the ureter is also dragged forward, when it would soon be compressed between the blood vessel and the pelvis. This actually is the whole story of what occurs. It sometimes happens that the inferior branch comes off from the renal artery so close to the kidney that the bulging pelvis cannot get above it, so that all the vessels are carried forward on it. In this way there cannot be any compression of the ureter by a blood vessel (Fig. 4); of course the inferior branch may come off the main vessel at any point, as we all know it sometimes comes off the aorta (Fig. 3). Naturally the latter conditions can provide a vascular complication for a hydronephrosis.

The next series of figures (Figs. 5 and 6) represent different stages of the hydronephrosis and show how the vascular compli-

cation occurs. We are taking a medial view of the renal hilum and we see how the pelvis goes forward dragging the ureter with it as the dilatation progresses, until finally we see what an important obstruction to the ureter can ultimately occur. An alternative method of demonstrating what has happened is seen in the next series of illustrations. Figure 7 is a posterior view of a left kidney. The divided ureter is gripped by forceps, and on

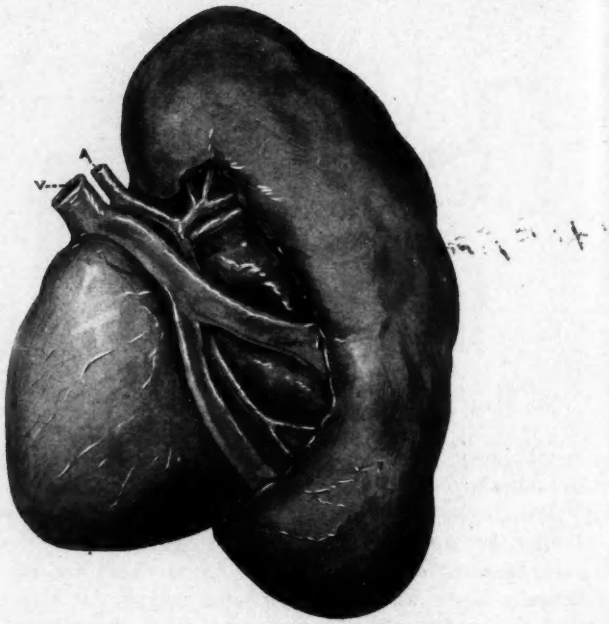
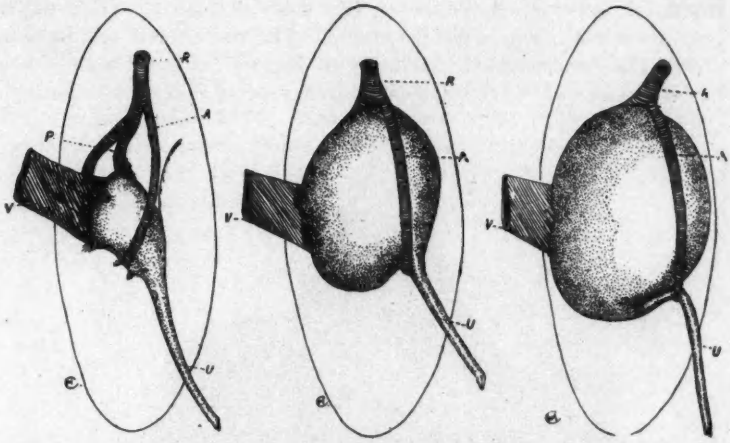
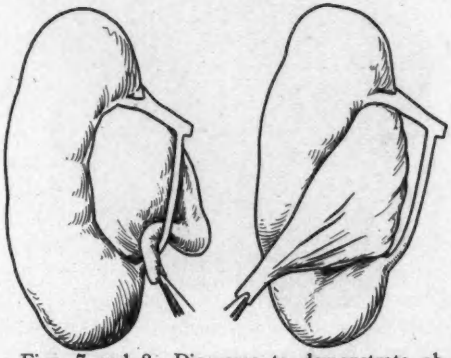


Fig. 4. Anterior view of a left hydronephrosis showing that the interval between the superior and inferior branches of the renal vessels is not large enough for the pelvis to project through.

pulling the ureter and pelvis backwards (Fig. 8) we see the parts restored to their normal relationship. So far I have made reference only to the artery as the obstructing vessel, but it can be easily understood that the same function can be performed by the vein, and the artery may take no part if the latter happens to come off the parent trunk close enough to the kidney.



Figs. 5 and 6. Diagrammatic representation showing how progressive stages of pelvic dilatation gradually become complicated by vascular obstruction of the ureter.



Figs. 7 and 8. Diagrams to demonstrate obstruction and relief of vascular obstruction of the ureter.

Now let me show you drawings of some of the specimens I collected; some are from the London Museums, and others are the result of my own operations. Figure 9 is most interesting. It is a hydronephrosis involving a kidney with a double pelvis. The kidney is a left one and we are looking at its medial aspect. The

dilatation involves the lower pelvis and its calices. The upper portion of the organ is not distended. The two ureters can be seen forming a junction and the lower of the two is compressed by a blood vessel. The vascular supply has been carefully dissected.

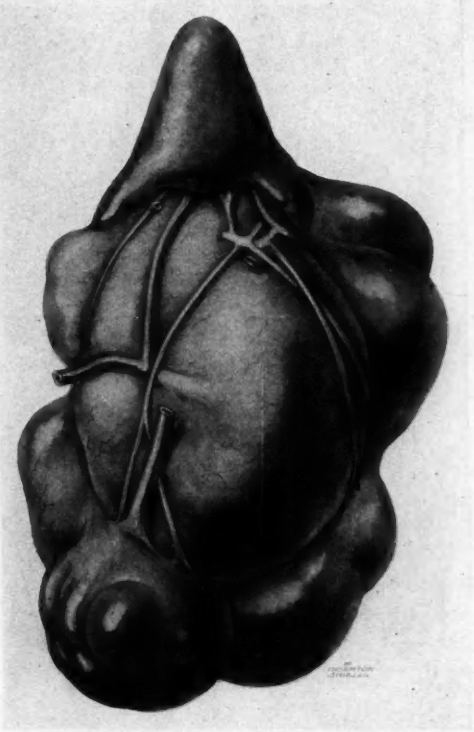


Fig. 9. Hydronephrosis of lower part of double knidney with obstruction to ureter by the inferior branch of renal artery.

As is usual with a hydronephrosis the arteries are in a state of atrophy and it is easy to distinguish them from the veins. The offending vessel is obviously the normal inferior branch of the renal artery, which has involved the lower ureter as the enlarging pelvis has gone forward. From the positions of the remaining

portions of the divided vein, it is more than likely that this structure also helped in the pressure on the ureter.

Figure 10 is a post mortem specimen. The right kidney is viewed from behind. It is easy to see how the distended pelvis has pushed its way forward in the interval between the upper and lower branches of the renal artery and how the ureter has been dragged with it, ultimately resulting in the looping of this structure over the lower blood vessel.

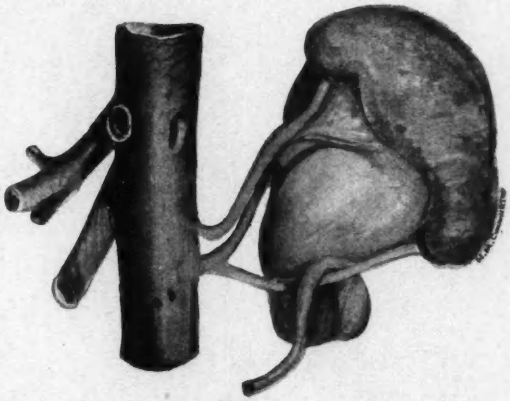


Fig. 10.

I have already referred to the fact that the corresponding vein of the inferior branch of the renal artery is often the vessel which causes the compression. I can show you a number of drawings illustrating this point. Figure 11 is a postero-medial view of a left kidney. It is easy to see how severe a compression of the ureter has occurred just because the distending pelvis has gradually worked its way forwards and dragged the ureter with it over the inferior branch of the renal vein.

Figure 12 is a similar specimen. We are looking at the posterior aspect of a left kidney. Notice the stump of the insignificant and atrophied renal artery above, and the wide interval between the superior and inferior branches of the renal vein; this forms an escape though which the lower part of the pelvis and the adjacent ureter must have passed forward long before the pelvis had

reached the size depicted in the illustration. It is obvious that the pelvis in its present bulk could not have found its way through this opening.

Figure 13 offers further evidence of the compression of the ureter by the normal inferior branch of the renal vein. We are looking at the postero-medial aspect of a left kidney. The vessel compressing the ureter is the normal inferior branch of the

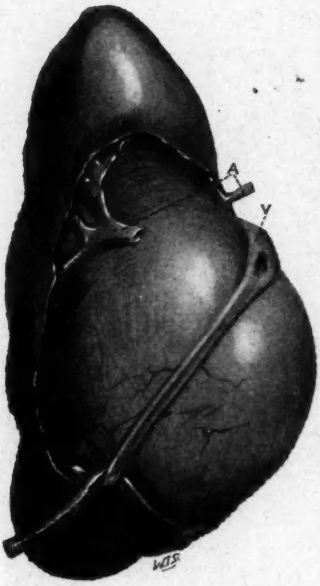


Fig. 11. *A*—branches of renal artery; *V*—renal vein.

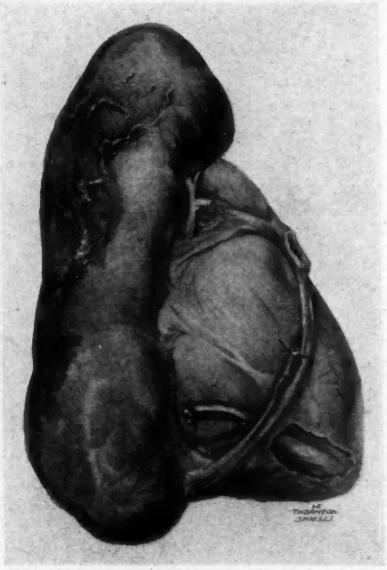


Fig. 12. Obstruction to ureter by the inferior branches of both renal artery and the vein. A window has been cut in the covering of fascia which overlies and compresses the ureter.

renal vein. The divided vessel overlying this is the corresponding artery and no doubt it was an equal factor in producing pressure. In this specimen it is so easy to see how the pelvis has pushed its way forward above the vessels in question to the detriment of the efficiency of the adjacent ureter. This specimen, by the way, illustrated a condition that one only occasionally sees in hydronephrosis, namely that of generalized atrophy. This

kidney was definitely smaller than a normal one when I removed it. I have had several other examples of this change.

Figure 14 illustrates again the important part that the inferior branch of the renal vein can play in obstructing the ureter. Once more we note the wide vascular interval which exists between the

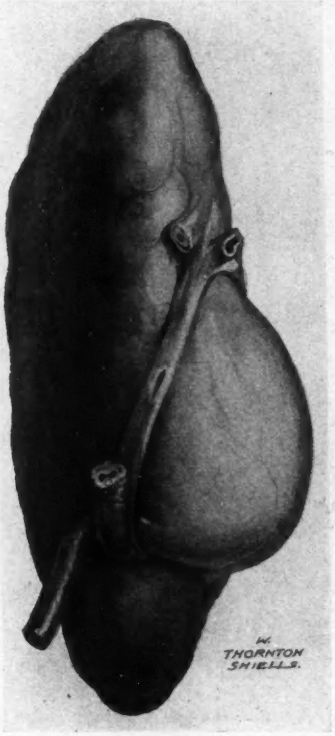


Fig. 13.

upper and lower branches of the renal blood vessels, a space which would be more than adequate to allow a small distending pelvis to pass forward. There is no doubt that the fact of finding such a blood vessel as this on the back of the pelvis, when one knows that its proper place is on the front, has led to the erro-

neous view that the vessel in question is an aberrant one. Here again we have an example of a pelvis which has increased very considerably in size after it has passed forward through the vascular interval.

Figure 15 is a postero-medial view of a right kidney. The pelvis has pushed its way forward over the inferior branch of the

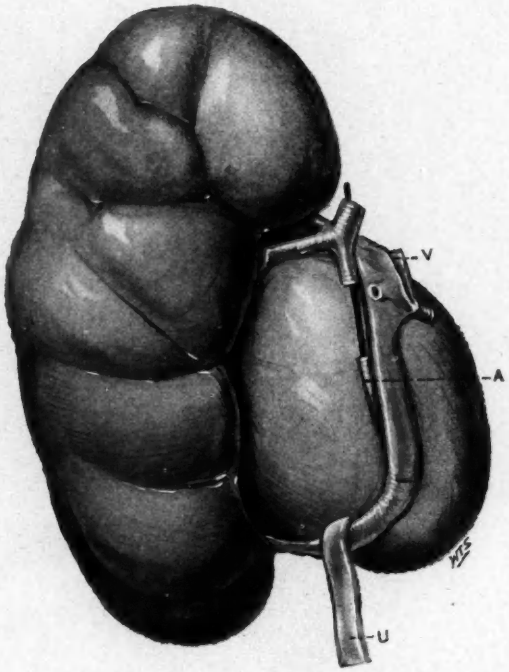


Fig. 14. *A*—artery; *V*—vein; *U*—ureter.

renal vein just sufficiently to bring it into contact with the ureter, so that obstruction is just commencing.

Figure 16 is an antero-medial view of a post-mortem specimen of a left hydronephrosis. Here we can see the lower part of the pelvis trying to push its way through the interval between the upper and lower branches of the renal vein. It has only partly

succeeded and the ureter appears to be but slightly involved by the blood vessels.

Figure 17 is a drawing of a quite extraordinary post-morten specimen. We are looking at the posterior aspect of a left hydronephrosis. The ureter is looped over an inferior tributary of the renal vein which obviously is arising in an abnormal situation at

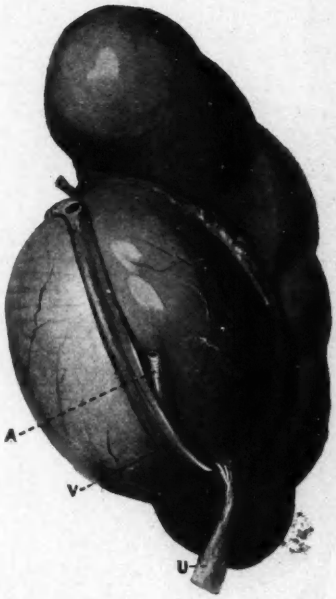


Fig. 15. *A*—artery; *V*—vein; *U*—ureter.

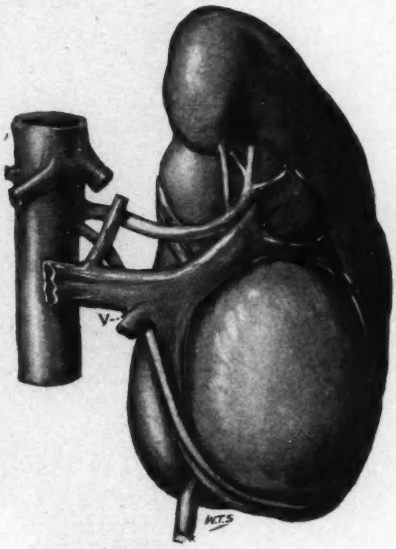


Fig. 16. *V*—vein.

the lower pole of the kidney. The key to the explanation of this specimen is to be found in a study of Figure 18. This is a drawing of a left kidney obtained at a post-morten examination. We are looking at it from the front. We see an accessory vein passing from the lower pole of the kidney across the ureter to join the spermatic vein. It is easy to see that, should a hydronephrosis occur, the forward projection of the pelvis would soon produce

a looping of the ureter over the vein in question, in the manner seen in the previous illustration.

In contemplating such a large pelvis as the hydronephrosis Fig. 17 represents, it is not difficult to understand how the more the pelvis distends the more obstruction occurs to the ureter.

Further consideration of the last two illustrations has tempted

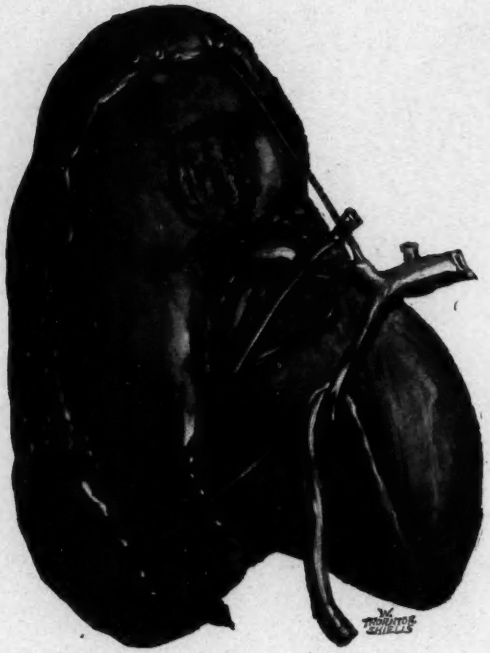


Fig. 17.

me to revise the original opinion that I published concerning Figure 19. In this I accepted the statement in the Museum catalogue that the vascular obstruction was due to an artery. I now seriously question the accuracy of this view for the reason that this specimen has the following features in common with Figures 17 and 18:

1. The offending vessel is attached to the outer surface of the lower pole of the kidney.
2. There is a limb of a divided vessel associated with it.

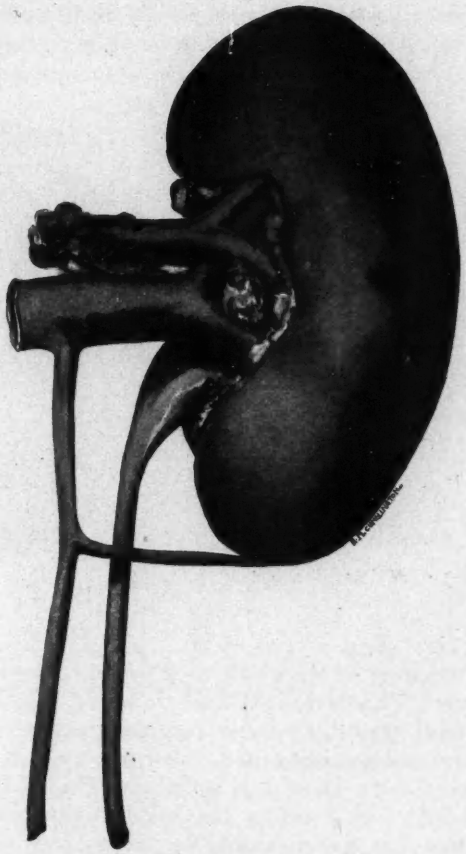


Fig. 18.

3. The kidney is a left one.
4. The size of the main trunk of the vessel is more in keeping with that of the vein rather than the artery.

In all these circumstances it is more than likely that the vessel in question is an aberrant tributary joining the spermatic or ovarian vein which, as we know, on the left side normally enters the renal vein.

Figure 20 is a posterior view of a right hydronephrosis. It is a specimen which also requires revision of my original opinion

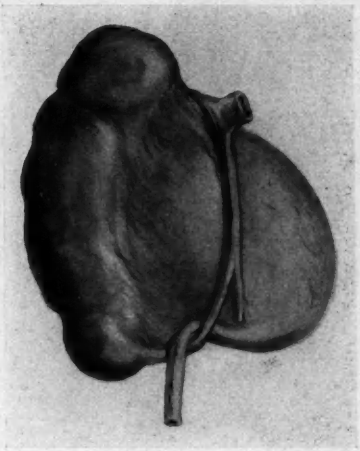


Fig. 19. Posterior view of a left hydronephrosis.

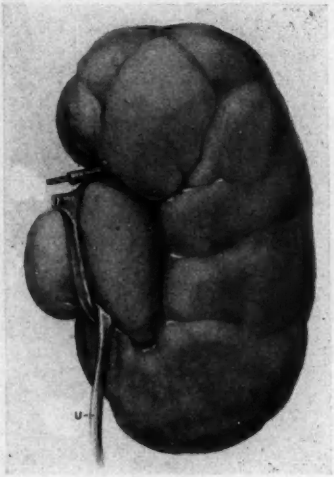


Fig. 20.

concerning the nature of the obstructing vessel. The latter is obviously the vein. I had described it as an artery. I confess I was led into this fault against my better judgment because the description in the Museum catalogue had fallen into this error. There was still another specimen in this collection (Fig. 11) where the same mistake had been made in the Museum catalogue, but the misinterpretation was too apparent for me to commit the same blunder.

The reason for the repeated hesitancy in the past to admit the important rôle to the vein instead of the artery, was because there was no known theory which would explain that state of affairs; while the only accepted explanation, namely, that of the

aberrant artery, was a strong temptation to place the case in that category.

As far as aberrant vessels are concerned, Figure 21 is an example of a post-mortem specimen showing a hydronephrosis and an abnormal renal artery which obviously is playing no part in causing the dilatation. One must be fair, however, and admit that there are examples where the obstructing vessel is an aber-

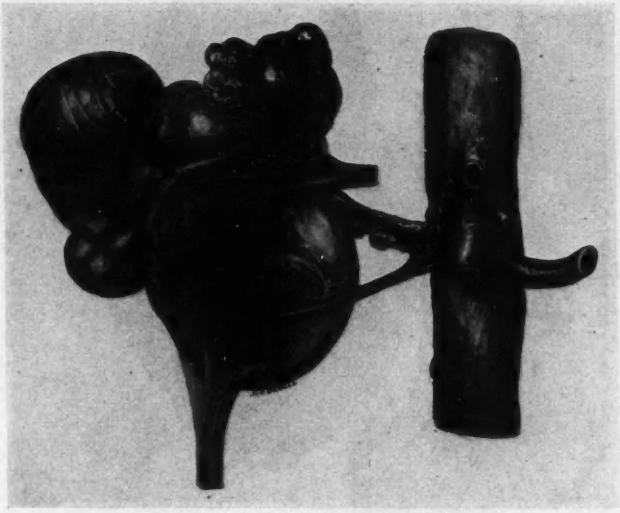


Fig. 21. An anterior view of the right kidney, and a portion of the aorta, from the front of which an aberrant artery arises. The kidney is not only hydronephrotic, but cystic.

rant artery inasmuch as it is generally the arterial stem to the lower part of the renal hilum which arises independently from the aorta instead of from the renal artery. The mechanism of the obstruction to the ureter, however, is no different from that which I have already described, except in this respect: that as the vascular interval is bigger than in other circumstances, it is easier for the pelvis to push forward. Figure 22 is an example. It is a post-mortem specimen of a right kidney viewed from behind.

I am sure that you will agree that in a large number of specimens of hydronephrosis which we remove in the course of our

work, there is evidence of compression of the ureter by a blood vessel, which as a rule has been divided in such a way that it is impossible to know the origin of the vessel in question. In showing you the following illustrations of some of my own nephrectomies you will no doubt recall similar appearances in some of your own cases. In view of the evidence which has been put for-

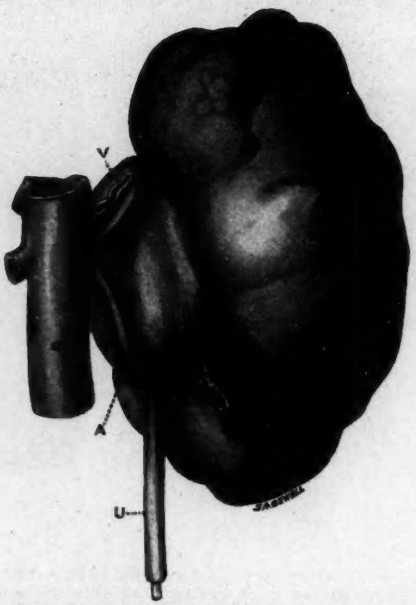


Fig. 22. *A*—artery; *V*—vein; *U*—ureter. The inferior branch of the renal artery has an independent origin from the aorta, and is compressing the ureter.

ward concerning blood vessels and hydronephrosis, it must be evident that the justification for concluding that any given hydronephrosis is due to an aberrant vessel is more than likely a very doubtful one (Figs. 23 and 24).

A word or two about treatment in these cases. I daresay we have all had experience of the relief of patients' symptoms as a result of the division of blood vessels which were found to be obstructing the ureter. There is nothing more certain than the

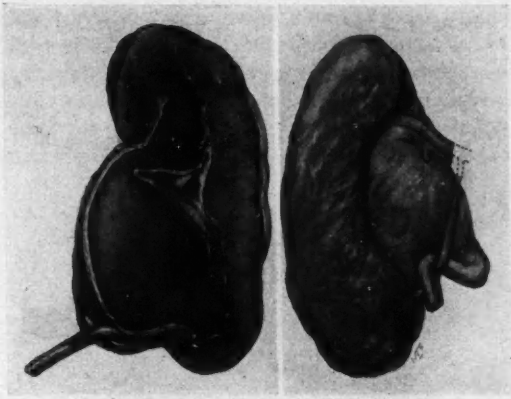


Fig. 23. (*left*) A posterior view in section of a right hydronephrosis (nephrectomy specimen). The inferior branch of the renal artery is seen compressing the ureter.

Fig. 24. (*right*) A posterior view of a left hydronephrosis (nephrectomy specimen). The groove on the pelvis suggested that the artery which involved the ureter was the normal inferior branch. This has been indicated by the dotted lines.

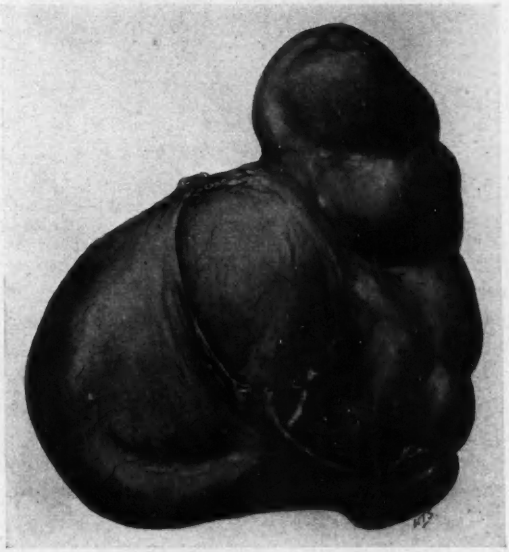


Fig. 25.

fact that these vessels can produce a more severe impediment to the outflow of urine than the initiating one, whatever it may be. Only proper control by urograms can give us the necessary information about the subsequent state of dilatation of the kidney after this kind of operation.

In those cases where the dilatation is very advanced, there is,

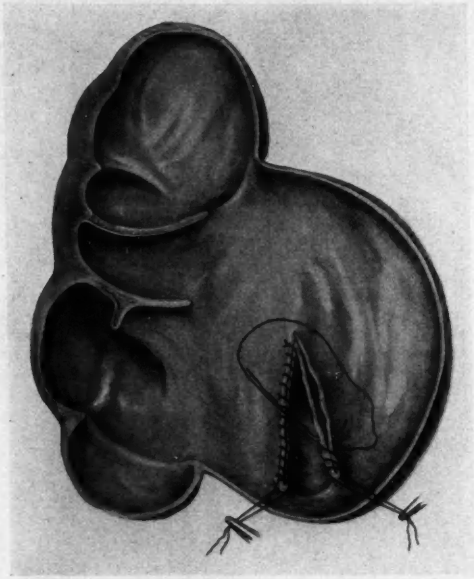


Fig. 26. A nephrectomy specimen of a hydronephrosis, used to demonstrate a simple method of enlarging the opening of the pelvis into the ureter. Note that in this case the first part of the ureter runs upwards on the back of the pelvis.

as a rule, a proportionate extent of the adjacent ureter adherent to the pelvis. If we study a well developed case carefully it will be apparent that something more than the mere division of an obstructing blood vessel is necessary to free the ureter. Let us look at Figure 25. We see a posterior view of a right hydronephrosis which I removed. There are two blood vessels crossing and obstructing the ureter; in this case the ureter is dilated up to the level

of the vessels but there is a mechanical factor additional to the blood vessels which is playing an important part. I refer to the sheath of fascia which surrounds the kidney and pelvis deep to the perinephric fat. The renal blood vessels lie in the substance of this tissue and it is inside this sheath that the ureter becomes flattened against the pelvis. In the specimen illustrated here, this

Fig. 27. A post-mortem kidney which shows that the inferior branch of the renal artery has been divided as a result of a gunshot injury. Note the necrosis of the lowest third of the kidney which has occurred.

envelope has been demonstrated by removing the portion of it which lies on the outer part of the back of the pelvis. It is obvious that a mere division of the vessels overlying the ureter would not also remove the constricting influence of the sheath which presses the ureter onto the pelvis.

Figure 12 demonstrated a dissection which illustrates the same point. A window cut over the ureter in the sheath throws the latter into relief.

If a kidney in such an advanced state of dilatation must be preserved, the establishment of a permanent nephrostomy probably

offers the most certain prospect of benefit, but sometimes a patient refuses to countenance permanent drainage from the loin.

If one does not wish to undertake an extensive plastic operation such as that practised by Von Lichtenberg, there is a perfectly simple procedure which will give considerable relief. The first step consists in opening the pelvis and identifying the ureteric orifice. After inserting a probe into the ureter so as to demonstrate its direction, one blade of a fine pointed pair of scissors is inserted. With the scissors the contiguous walls of the ureter and pelvis are cut in the long axis of the ureter. Two lines of continuous catgut sutures are then inserted in such a way as to make an extensive opening from the pelvis into the ureter (Fig. 26). The interesting point about this procedure is that although the ureter may be constricted by a blood vessel there is no danger of injuring this with the scissors, as it is the opposite wall of the ureter to that on which the vessel lies which is cut.

To return to the question of dividing a constricting blood vessel, we are always faced with the danger of very serious results of interfering with the blood supply of the lower pole of the kidney. One of the most striking illustrations of this effect was published in an article on war injuries of the kidney in the *British Journal of Surgery* some years ago by the late Andrew Fullerton.

Figure 27 is a photograph of this illustration which shows that the inferior branch of the renal artery has been severed and the consequent necrosis to its region of supply in the kidney. One is well aware that this vessel has more than once been intentionally divided, without any indication that such a complication had occurred. On the other hand gangrene of the lower pole of the kidney with death has been reported.

There is not the time at my disposal to go deeply into the subject of treatment. But I would say this: that the results of plastic procedures which I have carried out to overcome obstruction have varied considerably, many giving relief for a time only so that, where there is no contra-indication, the patient is indeed fortunate where nephrectomy is the procedure of choice.

DISCUSSION

DR. EDWARD L. KEYES (New York, N. Y.): I am so nearly dead myself that I am delighted to be the first to praise as much as in me lies the obituary which Mr. Winsbury-White has pronounced upon the aberrant artery. This is altogether admirable. I have had the interesting experience in one case only, alas, probably because we don't operate on these patients very early, of actually disengaging a hydronephrotic kidney pelvis from an aberrant vessel. It was in the pocket, as he has so nicely shown you. I pulled it out of the pocket, stuffed some fat into the pocket to keep it from going back, and with some sutures so held it. Subsequent pyelogram showed that, while the kidney pelvis remained somewhat dilated, it had not lapsed back into the pocket, but the patient continued, though improved, to have occasional colics and symptoms of retention, which bears out, I call to your attention, Mr. Winsbury-White's observation that the hydronephrosis precedes the vascular obstruction and occasions this. We have managed to keep this boy going by occasional dilatations of the upper end of the ureter, but he does not seem to have much of a stricture there; perhaps it is more spasmodic than strictural.

I am as skeptical as anyone of the virtue of dilatation of the upper end of the ureter; the lower end, it may be said, as well.

You will ask why we all cut vessels and cure hydronephrosis. If the hydronephrosis was there already, as Mr. Winsbury-White says, how can we cure it by cutting the vessel? I fancy that is because the vessel in obstructing the pelvis secondarily actually cures the hydronephrosis ultimately by dilating the original obstruction above. It thereby puts the patient in a position where he is not obliged, like my patient who was operated on early, to have any subsequent treatment.

MR. H. P. WINSBURY-WHITE (London, England): I thank Dr. Keyes for the little tip he has given me in filling up the vascular interval with a pad of fat. I shall remember it and try it out in the next case that seems a convenient one in which to use this method. I thank you also for your kind reception of my words.

THIRD DAY, MAY 27, 1936

PELVIC SINGLE KIDNEYS

A. R. STEVENS, M.D.

New York, New York

Abnormalities of the upper urinary tract have been described from many angles. The clinical significance of the developmental irregularities has been better appreciated as experiences and reports have multiplied and complete investigation of the individual patient has become more general.

We are concerned here with the subject of "single" or "solitary" kidneys, referring to the embryologic status and not to the anatomic form, which would include such anomalies as "horse-shoe" and "fused" kidneys, and will consider only ectopic single kidneys and even further confine the topic to "pelvic single kidneys," because of the peculiar difficulty encountered in dealing with the therapeutic problems presented.

The ectopic kidney was well known to earlier writers. In the sixteenth century, instances were frequently related by anatomists. Thus, Casper Baubin, who first described the ileocecal valve, has figured in his "Theatrum Anatomicum" a left kidney situated at the bifurcation of the aorta in front of the sacrum and supplied by vessels from the right iliac artery and the aorta. Subsequently similar cases were recorded by Eustachius, Bartholin, Botall and Wrisberg. But it is only in comparatively recent times that the ectopic kidney has claimed more than anatomic interest. Indeed it has usually been discovered only by chance, either at necropsy or in the course of an operation for some other condition, and occasionally during a routine urologic examination. In exceptional cases, chiefly of gynecologic or obstetric nature, there are symptoms referable to the kidney.

In our present discussion the following figures are of interest. Necropsy records, derived from many sources,[1, 2, 7, 8, 10, 18, 19, 21, 29] indicate that ectopic kidneys are found once in from 500 to 1,100 autopsies, whereas true pelvic kidneys occur once in from 2,150 to 3,000 autopsies. In other words, every third or fourth ectopic kidney is a pelvic one. Single kidneys (unilateral renal agenesis) were found once in from 700 to 1,610 autopsies, as recorded in

PUBLISHED CASES OF PELVIC SINGLE KIDNEYS

Case No.	Ref. No.	Author	Year Reported	Age	Sex	Anomalies Noted (Genital, etc.)	Clinical Diagnosis	Urologic Findings	Operation	Result	Blood Supplies
1	20	Henot	1830	8 mo. fetus		All genitalia absent; sex indefinite			Autopsy		
2	22	Merrier	1854	47 yrs.			Carcinoma of left hypochondrium	Pelvic, rounded kidney	Autopsy		
3	30	Watson, M.	1874				Pathologic specimen only		Autopsy		Left renal artery from bifurcation of aorta; divided into 2 branches, entered upper pole of pelvic kidney
4	17	Hebb, R. G.	1885	6 yrs.				Dilated single ureter. Kidney almost normal	Autopsy		3 arteries from aorta above bifurcation; 2 from interior iliac. Vein from upper half of kidney to internal iliac; from lower half to common iliac
5	15	Guelmi, A., and Ciniselli, G.	1887	10 yrs.	F	Uterus, broad ligament and ovary at 12th dorsal vertebra; vagina absent		Ureter dilated. Kidney elliptical	Autopsy	Died—uremia due to parenchymatous nephritis	
6	27	Strube, G.	1894	1 mo.	M	Ano-vesical atresia		Right pelvic solitary kidney of irregular shape	For atresia	Died, 1 mo. after operation	3 renal arteries (1 right; 2 left); 2 from left common iliac artery
7	3	Barlier and Broussole	1895								

8	9	Chretien	1895	3 mos.				Dilated ureter	Autopsy		
9	6	Buss, O.	1899	21 yrs.	F	Vagina absent. Fibromata in ovaries	Ovarian tumor		Extirpation of of tumor and kidney	Died of anuria	
10	31	Winter, G. J.	1905	21 yrs.			Abdominal tumor		Extirpation of kidney	Died of anuria	
11	11	Cullen, T. S.	1910	17 yrs.	F	Vagina absent. Both tubes and ovaries in inguinal canals	Uterine tumor		Exploratory operation		
12	12	Cutore, G. (Cited by Tachot)	1910		F	Vagina and uterus absent. Tubes and ovaries rudimentary		Kidney contained a calculus. Dilated ureter			
13	14	Galtschmann, V. I.	1910	30 yrs.	F	Uterus bicornate	Abdominal tumor		Exploratory laparotomy		
14	25	Rolleston, I. D.	1916	14 yrs.	M	Mentally defective		Dilated pelvis and calices. Dilated ureter	Autopsy	Died of scarlet fever	
15	26	Schultz	1918	18 yrs.			Abdominal tumor	Exploratory laparotomy. Puncture and biopsy, kidney	Died one week after operation		Artery to kidney trom aorta
16	21	Judd, E. S., and Harrington, S. W.	1919			Malformation liver and duodenum	Ovarian cyst		Laparotomy		
17	21	Judd and Harrington	1919								
18	13	Day, R. V.	1924	20 yrs.	F	Vagina, uterus, left tube and ovary absent		Only one ureteral orifice	Laparotomy; opened kidney for uterus	Living	
19	24	Roeder, C. A.	1925		F	Vagina, uterus and left adnexa absent			Laparotomy, appendectomy		"Kidney pelvis posterior to renal vessels pointing up and outward"

Case No.	Ref. No.	Author	Year Reported	Age	Sex	Anomalies Noted (Genital, etc.)	Clinical Diagnosis	Urologic Findings	Operation	Result	Blood Supplies
20	4	Bitschai, J.	1925	20 yrs.	F	Vagina absent		Only one ureteral orifice	No operation (clinical report)	Living	
21	5	Bratrud, E.	1929	48 yrs.	M		Appendicitis		No operation	Living	
22	19	Hennessey, R. A.	1929	19 yrs.	F	Never menstruated		Only one ureteral orifice; pyonephrosis	No operation	Died	One renal artery from bifurcation of aorta. One renal vein enters bifurcation of vena cava
23	28	Tachot	1931	44 yrs.	F	Vagina absent. Never menstruated	Renal calculus	Hydonephrosis with calculus	Transperitoneal lithotomy through kidney cortex	Urinary fistula. Died 3 yrs. later of uremia	No note on blood vessels
24	16	Gutierrez, R.	1933	32 yrs.	F	Hypothyroid. Never menstruated. Genital anomalies		Diagnosis by retrograde and intravenous pyelograms	No operation. Renal lavage only		
25	23	Nesbit, R. M.	1935	8 yrs.	M		Urinary retention	Large abdominal mass. (Hydronephrosis-1500 c.c.)	Nephrostomy	Living 9 yrs. later	
26		Stevens, A. R.	1936	31 yrs.	F	Rudimentary vagina	Abdominal and pelvic mass	Right ureteral ridge and orifice only. Pyelogram	No operation	Living	
27		Stevens, A. R.	1936	30 yrs.	M	No abnormalities	Calculi in pelvic kidney	Right ureteral ridge and orifice only. Pyelograms by retrograde and intravenous methods	Lithotomy	Living and well 8 mos. later	

widely scattered reports. In 1932, Collins had found 572 cases of unilateral renal agenesis in the literature with forty-nine other probable ones, and added nine of his own. In the present study, I have found reports of twenty-five cases of single kidneys located in the bony pelvis, and add two of my own. We may, therefore, presume that approximately only 4 or 5 per cent of single kidneys are true pelvic ones. Speaking in round figures, if we may expect a solitary kidney once in every 1,000 persons, there will be a solitary pelvic kidney in one of about every 22,000 persons.

The indications for treatment of ectopic kidneys, surgical or otherwise, are in general governed by the well known urologic principles employed when the organs are normally situated. However, because of the relatively poor drainage and mild hydronephrosis universally present in ectopic kidneys, and the irregular and frequently multiple blood supply, nephrectomy is more commonly demanded (when there is present elsewhere in the body a normal kidney). This drastic treatment is more often applied to the pelvic type than to other ectopic kidneys, because of the increased difficulty of approach and of the frequently bilateral blood supply. When the pelvic kidney is the only one present, one recognizes the gravity of the situation because of the vital need of and at the same time the increased difficulty of conservatism. In contrast, other ectopic kidneys usually have the vascular attachments on one side only, and their situations are more accessible.

The blood supply of pelvic kidneys is variable, coming from the bifurcation of the aorta, the common iliacs, external or internal iliacs, median sacral and other neighboring vessels. The veins are usually correspondingly attached. It is well to repeat the frequently stated fact that, contrary to conditions found in ectopic kidneys, the blood supply of a floating kidney is in origin the same as that of the normally placed organs.

In the series of twenty-seven pelvic single kidneys reviewed here, satisfactory descriptions of blood supply are few. In three cases, including my operative one, the vessels supplying the kidney apparently came from the region of the bifurcation of the aorta only (none entering the kidney laterally), making possible a freer manipulation of the kidney for conservative measures. The sex was stated sixteen times, five males and eleven females. The ages vary from a fetus up to forty-eight years. Calculus was noted

three times, with successful operation twice (including the appended report). There was noted fourteen times some abnormality or deficiency of the sexual apparatus (all in women), which is a common finding. Many of this group were necropsy observations; others were clinical findings, with no treatment of the urinary tract indicated. But eleven of the patients had some operation which concerned the renal condition. In two cases, the single kidneys were removed together with or for supposed neoplasm (both patients reported over twenty-five years ago), with, of course, subsequent anuria and death. There were four exploratory laparotomies, with appendectomy in one case. One kidney was not recognized as such, was punctured and tissue removed, for diagnosis; another was mistaken for the uterus and opened, but promptly closed. Nephrostomy was performed once and lithotomy twice, all successful operations.

The gross errors are noted chiefly in earlier publications. The prevalent general use of cystoscopic and roentgenographic investigations supplies one with ample data to forewarn and guide the surgeon.

CASE REPORTS OF PELVIC SINGLE KIDNEYS

Case 1.—E. F., a married woman, thirty-one years old, a native of this country, of Italian ancestry, was seen at Bellevue Hospital in December, 1929. She complained of attacks of pain in the right lower quadrant of the abdomen during the previous year, and urinary frequency since childhood.

There had been surgical reconstruction of a rudimentary vagina at seventeen years of age, and appendectomy at eighteen. The patient married at twenty-one, had not been pregnant, and had never menstruated.

Examination of the abdomen disclosed the scars of operation, no masses palpated in the loins but a large mass felt in the bony pelvis, also per rectum. Cystoscopy revealed a normal right ureteral ridge and ureteral orifice, but neither ridge nor orifice on the left side. Catheter passed over 10 cm. up the right ureter, obtained clear urine, normal microscopically. Indigo-carmine given intravenously came from the ureteral catheter in two and one-half minutes, but none appeared in the bladder. The test was repeated on another day with the same result. Also a Garceau catheter was used to plug the ureteral orifice, and while 15 c.c. of urine was collected through that catheter, none appeared in the bladder. Roentgenograms showed no outlines suggestive of kidney in either costovertebral region. A pyelogram (Fig.

1) proved the right kidney to be lodged in the bony pelvis. No operation was indicated, and the patient left the hospital.

Case 2.—G. J. P., a man, thirty years old, single, native of Italy, was first seen in September, 1935. For four years he had had attacks of pain in the right lower quadrant of the abdomen, radiating sometimes to the right testicle and sometimes along the anterior thigh to the right knee. Pains were usually dull in character, but recently more severe and more frequent. He has never passed a stone. There was hematuria once, in June, 1935. Roentgenogram taken elsewhere (Fig. 2) showed three shadows in the bony pelvis. These were

Fig. 1. Case 1. Pelvic single kidney; no operation. Clinical observation.

called vesical calculi and the doctor tried to confirm this supposition by passage of sounds. Appendectomy had been done two years earlier for this same pain, without relief. General health has been good, but bowels were irregular with much tendency to abdominal distention.

Examination.—The patient was a slim, small man. Chest was normal. Liver and spleen were not palpated. Neither kidney was felt in the usual situations, but a large mass was encountered in the middle and right portions of the pelvis. External genitalia were normal except for a large cyst in the upper pole of the left epididymis. Both testicles were normal. Rectal palpation disclosed a small, symmetrical prostate of normal consistence. The seminal vesicles were not clearly defined. Most of the pelvis was occupied by a firm mass,

easily felt against a hand on the abdomen. Urine specimens, passed successively in several containers, were all cloudy; there was a faint trace of albumin, no sugar, many red blood cells and few scattered pus cells.

An x-ray film showed three shadows averaging 1 cm. in diameter located in the sacral region, within the outline of a clearly defined mass.

Cystoscopy.—The bladder was generally normal. The right ureteral ridge was clearly outlined, with an ureteral orifice normal in outline and situation. There was no corresponding ridge and orifice

Fig. 2 *(left)*. Case 2. The calculi in pelvic single kidney.

on the left side. The right ureteral orifice was catheterized 20 cm. (the catheter would go no further). Urine in abundance was obtained; it contained red blood cells and scattered pus cells, no bacteria in stained smears. Indigo-carmine injected intravenously appeared from the catheter in four minutes in deep concentration, but after twenty minutes' observation there was no dye or urine in the bladder.

A urogram (Fig. 3) showed a right ureter leading to a pelvic kidney; the shadows noted on the earlier films appeared as filling defects in the small renal pelvis and a lower calix. Stereoscopic films proved the lower bodies to be in an *anterior* calix (a great help at operation). The calices were large and rounded and irregularly distributed. There was no kidney outline in the costovertebral region

on any film. Intravenous pyelograms, made another day, demonstrated the same outlines in the pelvis but no evidence of renal tissue elsewhere. The output of phenolsulphonephthalein was good, and the blood chemistry normal.

Operation.—On October 1, 1935, under spinal anaesthesia (nupercain), a right rectus incision was made from above the umbilicus to the symphysis. The rectus was retracted towards the midline. Because of adhesions presumably secondary to the appendix operation, the peritoneum was freed from the right pelvic wall with difficulty. There was little perirenal fat about the mass, and exposure was made

Fig. 3 *(right).* Case 2. Retrograde pyelogram. Calculi appear as filling defects.

on both sides. On the left, a loop of ureter was located, but its attachment to the kidney was in the left posterior aspect of that organ. A large vein (1 cm. in diameter) and an accompanying single artery the size of a lead pencil entered the kidney posteriorly, below its upper pole. Dissection was cautiously continued about the lower pole without encountering other blood vessels, and the kidney was delivered from the wound. The ureter was incised as it entered the kidney; the pelvis was obviously intrarenal. With a clamp, one stone (that originally in the pelvis) was located in an upper calix, and removed. The stereoscopic demonstration of the location of the other two stones helped materially to find them in a lower anterior calix, and they were removed without incision of the renal cortex. The mass was

replaced in its original bed and cigarette drains placed on both sides. The wound was closed in the usual manner.

The kidney mass was thick and rounded, with none of the usual renal form, and in bulk was about equal to two normal kidneys. The entrance of the ureter was on the left posterior aspect, between the upper and middle thirds, and below the attachment of the blood vessels.

Following the operation, all urine came from the wound for several days. The blood urea-nitrogen gradually climbed to 96 on the sixth day, but reached normal by the eleventh day after operation. As but little urine was passed per urethram the first two and one-half weeks, a ureteral catheter was placed 13 cm. up the ureter and allowed to remain three days, during which time nearly all of the urine drained per catheter. After its removal, there was normal urination, accompanied by some (but less) drainage from the wound. Five weeks after operation, another catheter was employed in the ureter for nearly two days. Following this, the wound leakage rapidly diminished, and the patient went home on the forty-seventh day, dry. The sinus closed in another few weeks.

The calculi removed at operation contained calcium oxalate only. The blood contained 11.75 mgm. of calcium and 1.8 of phosphorus per 100 c.c. The urine, which had been infected, became gradually clearer and in about three months was free from pus and bacteria. Chronic prostatitis, a possible source of future infection, was treated by massage. X-ray examination four months after operation showed no evidence of calculus.

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RADIO-SENSITIVE KIDNEY TUMORS

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In the last several years irradiation of kidney tumors has been advocated as possibly solving the difficult question of the cure of these tumors. We have at hand many interesting data both in the literature and in our own case records at the Memorial Hospital, data which shed a good deal of light upon the effects of irradiation of these growths. A good many years ago we demonstrated that certain large metastatic testicular tumors could be cured by external irradiation. I saw a short time ago the first patient so treated at the Memorial Hospital. He was one of Keyes' cases; proved by pathologic examination; irradiated by Janeway. He had a very large abdominal metastasis. He has now been well seventeen years. The pathologic anatomy of these testicular tumors is quite different from that of kidney tumors. The original asterial supply to the retroperitoneal glands is very small, that to the kidney proportionately large; the glands more fixed, the kidney movable. If one of the principal effects of irradiation is achieved by a sclerosing of blood vessels then we would expect more permanent results with testicular than with kidney tumors. This is apparently the fact.

The large Wilms' tumors of children proved to be quite as radiosensitive as the metastatic teratoma; showing the same remarkable primary regression. The regression seemed to be temporary, however. The kidney tumors grew again after perhaps a few months. When again irradiated they did not recede as readily as at first. And if irradiation therapy alone was used the patient succumbed to the disease. This led to the suggestion by Randall, Waters, ourselves and others that following the primary regression, nephrectomy upon the now small kidney tumor might offer possibilities of cure.

All of the above work obviously was undertaken because the curative results of operation were almost nil.

RESULTS OF NEPHRECTOMY ALONE

Priestly and Broders (Jour. Urol., Vol. 33, No. 6) report two cases, one patient living thirteen years and two months, and one living three years and three months, respectively, after nephrectomy. These two are from a series of sixty-five cases of Wilms' tumor in twenty of which nephrectomy was performed. One of their conclusions sums up this paper: "The group who were treated by irradiation and nephrectomy survived approximately twice as long as the group who were treated by operation or irradiation separately. No patient to our knowledge has been cured of Wilms' tumor by irradiation alone."

Alcock (personal communication) reports that among nephrectomized patients the mortality rate in the first eighteen or twenty-one months was just 100 per cent.

Other authors report that in children 90 per cent die in the first year postoperative (Hyman, Kretschmer, et al.). The operative mortality is between 15 and 30 per cent. A large number of cases are inoperable.

RECORD OF IRRADIATION FOLLOWED BY OPERATIVE REMOVAL

Randall has reported several cases, none of which has survived for long following nephrectomy.

Waters (Amer. Jour. Roentgen., February, 1935) reports three cases:

Case 1.—Hypernephroma? Irradiated as follows: Total tumor dose, three series, 4400 R. Nephrectomy nine months after irradiation began. Died one year and six months after admission from pulmonary metastases.

Case 2.—Hypernephroma? Irradiated, two series, total tumor dose 2749 R. Nephrectomy after irradiation began. Died in one year of pyelonephritis.

Case 3.—Adeno-carcinoma? Type found in young children. Irradiation; one series; total tumor dose 1454 R. Nephrectomy. Well four months after admission.

Alcock reports a tumor of the kidney in a little girl, three and one-half years of age. She was irradiated for six weeks and the kidney removed. She is alive and well approximately three years after she was first seen.

I have two patients (Cases 7 and 10), one of whom died six months after admission and four months after an easily performed

nephrectomy. During this time the patient developed a chest metastasis, which was controlled by irradiation. She died of a brain metastasis. The second patient is dying eight months after admission and five months after nephrectomy. The kidney tumor in this second case did not recede under irradiation. It was pathologically diagnosed as "an aberrant type of polycystic kidney with tumor formation."

The record of patients upon whom kidney tumors have been removed after irradiation is not brilliant. Their life span has apparently not been much lengthened.

Unquestionably the operative hazard is less if the kidney reduces in size following irradiation. Many authors have emphasized this. As far as my brief experience goes we have been too impatient to remove the tumor after the irradiation. Ewing has emphasized this. And as far as we can see from case records most surgeons have so indulged themselves. We believed that the time of election of removal of such tumors was when they had reached their maximal regression after the irradiation, generally from one to two months. We are convinced that irradiation should be continued somewhat longer and that operative removal should be deferred as long as possible.

Waters, however, has had two cases in which operation was deferred for nine months and seven months, respectively, after the beginning of irradiation. Neither had a successful outcome, one patient dying in one year and one in one and one-half years.

RESULTS OF EXCISING KIDNEY FOR SPECIMEN

Cutting into tumors composed of highly malignant cells would seem theoretically at least to be perilous. In four of our ten cases because of squeezing the kidney or cutting or breaking into it at the time of operation there were rapid local recurrences. In one of these cases there had been inadequate pre-operative irradiation of the kidney.

One could not help coming to the very positive conclusion that incising these tumors for purposes of diagnosis should not be done. If the kidney is not removed one should be content to rest his diagnosis upon the pyelogram, the tumor mass and its reaction to irradiation. Once in a while an exception crops up and incision into a kidney tumor apparently does no harm.

Whorton (Arch. Surg., Vol. 30, No. 1) removed a specimen from a large inoperable kidney tumor. Biopsy showed hypernephroma. Under irradiation it gradually reduced in size and the patient has gone three years in nearly normal health.

One such rare exception should not change our views on the danger of biopsy.

RESULT OF BREAKING INTO KIDNEY TUMOR AT OPERATION

The record cited above indicates the great hazard in operative removal of these tumors. In one of our cases (Case 10) I had to perforce cut into what appeared to be a relatively non-malignant cyst and evacuate the cyst contents in order to remove an enormous kidney tumor. The kidney had been inadequately irradiated for one month previous to operation, but the kidney mass had not receded like a Wilms' tumor. The pathologic examination of the removed tumor showed "radiation changes with active disease present." Because of incising this cyst the tumor almost immediately recurred locally.

It is obvious that no attempt should be made to remove very large tumors, which are thought to be highly malignant.

OPERATION CAUSING METASTASES

Theoretically the trauma resultant from the exploration of, the attempt at removal or the actual removal of a Wilms' tumor is an ideal method of releasing tumor cells which enter the blood stream and cause distant metastases.

In six of our ten cases there were distant metastases; four patients had had nephrectomy, one nephrotomy and one no operation. In the four cases that had no distant metastases four had had either nephrectomy or nephrotomy. Our cases are too few to give much support to this theory.

Transperitoneal nephrectomy is the operation of choice and should prevent metastases in a certain percentage of cases.

TYPE OF IRRADIATION USED

In our series as measured by the pathologic reports on removed and irradiated kidneys and by end-results, sufficient irradiation to control the primary tumor was not or could not be given. In Case 7 of our series, however, the tumor was reduced to "necrotic

shadow cells" by the high voltage x-ray treatment. Many years ago when x-ray treatments first started one massive dose or several large doses in a short period of time was the method used. The trend of the time has been toward smaller doses prolonged for a longer time.

I believe that in a certain number of cases high voltage x-ray treatment, if properly given, can indefinitely control Wilms' tumor of the kidney. We have an adequate instrument if we only know how to use it. But more of this later.

REACTION TO IRRADIATION

Observing radiation effects upon children one is impressed with two reactions. Apparently the skin of children stands irradiation better than the skin of adults, but the general condition of children is more affected. In particular they develop a leukopenia; the hemoglobin and red blood cells remain the same or even improve.

The patient in Case 7 showed a drop of 5,000 in her white blood cells in a month. If the white blood cells drop too low irradiation has to be discontinued.

Rarely the irradiation causes severe and even fatal bleeding. We have had one such case at the Memorial Hospital. The patient urinated almost pure blood and succumbed to this violent hemorrhage.

CURES OF IRRADIATION ALONE

We have been able to collect from the literature and our own records six cases where irradiation alone has apparently controlled the disease. The fact that such cases exist encourage us to further attempts in persisting in exploring the possibilities of high voltage irradiation.

CASE REPORTS

(Other than author's)

Case 1.—(unpublished). A patient who had a very large tumor of the kidney in which the pyelogram, while not absolutely typical of a kidney tumor, showed a filling defect of one calix. No specimen was obtained. The patient was first seen in June, 1935. Two cycles of deep x-ray therapy were given her. She had 2,400 r. to each of three portals t.s.d. 70 cm., 300 r. daily dose. The kidney became entirely normal in size and the pyelogram became normal. At the present time the patient is in normal health, eleven months after she was first seen.

Case 2.—McNeal (personal communication) had a child fourteen months old who was first seen on September 13, 1934. The child had a kidney tumor entirely filling her left abdomen. The pyelogram was typical. No pathologic specimen. She was put on very low doses of high voltage x-ray—200 r. for two or three doses, then less than 100 r. daily for five months. The tumor absolutely disappeared. The child has had several cycles of x-ray since then. She is now entirely well one year and eight months after first seen. She has gained eleven pounds and no tumor is palpable.

Case 3.—Wharton (Archives of Surgery, Vol. 30, No. 1) reports a patient fifty-one years of age with an inoperable kidney tumor from which a specimen showed hypernephroma. It gradually reduced in size under irradiation. The patient has gone three years in nearly normal health.

Case 4.—Waters reports a case of tumor of the kidney, the pyelogram of which showed a typical picture of hypernephroma. The patient was first seen in 1923. Under irradiation the tumor decreased in size, so that it was barely palpable. Operation was advised, but was not carried out. The patient died five and one-half years later. The cause of death unknown.

Case 5.—Sisk (personal communication) reports a case of tumor of the kidney in a child ten months old admitted to the Wisconsin General Hospital on February 25, 1931. For more than three months the mother noted that there was present in the left side of the abdomen a large tumor mass. This mass was found to extend from the costal margin to 4 cm. below the umbilicus and to the midline. The veins of the skin overlying the mass were greatly dilated. Excretory urogram showed the deformity of the tumor. The child was very anemic and was given blood transfusions. On March 17, 1931, the tumor was explored through a transperitoneal incision. It was found to be tremendous in size, extremely vascular and to extend to the middle of the spine. It seemed hopelessly inoperable, so the wound was closed. X-ray therapy was instituted and carried out under the direction of Dr. Ernst Pohle of the Department of Radiology. The child was in and out of the hospital at frequent intervals for observation and x-ray therapy. On June 30, 1932, another operation was performed, because at this time the mass had been so greatly reduced that it could no longer be felt. It seemed wise to do a nephrectomy and the kidney was exposed through a flank incision. The following notation is copied from the operative sheet and is, I think, of especial interest: "The kidney was normal in size with a tumor mass involving the pedicle and extending to and along the great vessels. As a result of this, the pedicle was about 1.5 inches in diameter. It was evident that nephrectomy would be of no benefit as a curative measure as the tumor in the pedicle and along the vessels could not be entirely removed." Again, the wound was closed without operation other than

exploration. Since that time the x-ray therapy has been continued. The patient has remained in excellent health and is now a fine, normal boy between six and seven years of age. A few months ago we had intravenous pyelo-ureterograms taken and were surprised to find a perfectly normal appearing pelvis on the left side, with functions apparently equal to that of the right kidney. Our last observation was on April 1, 1936. At that time no evidence of tumor mass or metastasis could be elicited either by physical examination or by x-ray.

Case 6.—Alcock (personal communication) reports a case of kidney tumor in a little boy about three and one-half years of age. On admission to the hospital he had a large visible tumor of the right kidney. According to the intravenous pyelogram the affected kidney had no function. Under x-ray therapy the tumor disappeared within six weeks to the point where you could palpate it and where x-ray pictures showed it to be approximately the size of a normal kidney. The parents refused operation and that kidney was never removed. The tumor disappeared under x-ray therapy. The function of the kidney by intravenous pyelography did return but the dye excretion was never as good in the affected kidney as in the normal kidney. The child was alive and well two and one-half years after we first saw him.

These six cases certainly demonstrate that some Wilms' tumors, at least, may be controlled by irradiation alone. The case of McNeal probably sheds more illumination on the proper trend of future irradiation than the others. It is quite extraordinary that small daily doses of less than 100 r. can permanently affect a Wilms' tumor of the kidney, and that this treatment could be continued for four months. The leukopenia which has followed irradiation so often and has necessitated the interruption of the treatment can possibly be avoided by these small daily doses. It is quite probable that the end-results of irradiation alone will not be as brilliant as in embryonal teratoma testis. But we apparently have a new lead in the treatment of this quite deadly disease. For those of us who believe that irradiation should be followed by nephrectomy it would seem to be proper to suggest that the primary irradiation should be in smaller daily doses over a longer period of time and that the operation should be deferred as long as possible. The failure of the tumor to recede under irradiation does not necessarily mean that the malignant tumor cells are not affected by the x-ray; and should not occasion haste in doing the nephrectomy.

CASE REPORTS (AUTHOR'S CASES)

Case 1.—Helen L. B., aged four years, was admitted to Memorial Hospital on August 14, 1928, with a history of pain in the left lower

abdomen beginning February 14, 1928. On February 21, 1928, a tumor of the kidney was removed at another hospital. On August 5, she again had pain in her abdomen and increasing constipation. She had some dysuria, occasional vomiting and loss of appetite. When admitted to the hospital she had an abdominal tumor extending from the left kidney region down to her pelvis and extending beyond the medium abdominal line. The mass was felt rectally. The pathologic examination of the primary tumor was "embryonal myosarcoma." Wilms' tumor of the kidney.

Radiation of tumor.—Radium pack from August 15, 1928, to September 8, 1928 (three weeks), the five treatments totaling 25,000 millicurie hours at a distance of 6 cm. and from two portals, anterior and posterior. High voltage x-ray from October 18, 1928, to December 27, 1928 (ten weeks). She had twelve treatments totaling 5,400 r. at a distance of 50 cm. and from three portals, anterior, lateral and posterior.

Regression of the tumor began on September 4, 1928, and on September 18, 1928, there was marked regression and her general condition became better. On December 16, 1928, there was distinct enlargement of the tumor. She died on February 12, 1929.

Comment.—Taking the radiation from the pack and x-ray this patient had fairly heavy radiation, probably as much as she could stand.

Case 2.—Wm. J., aged four years, was admitted to the Memorial Hospital November 13, 1928, with a history ten months previously of dysuria and hematuria with loss of appetite and anemia. On August 4, 1928, a kidney tumor was removed at an outside hospital. He improved for two months when he again lost weight and appetite and complained of abdominal pain. When he came to the hospital he had a tumor occupying the entire left side of his abdomen extending down into his pelvis. His liver was greatly enlarged. The pathologic examination of the primary kidney tumor showed "a small celled, malignant tumor Grade IV, radio-sensitive." A very anaplastic tumor; Wilms' tumor.

High voltage x-ray treatment consisted of nine treatments between November 13, 1928, and December 18, 1928 (five weeks), totaling 4,500 r. at a distance of 50 cm. from three portals of entry, anterior, lateral and posterior.

In spite of a transfusion his hemoglobin reached 55 per cent and red blood cells 2,740,000 on December 28, 1928, and it was impossible to give more irradiation.

There was some regression of the tumor. The patient died on February 6, 1929.

Comment.—This was a fair amount of radiation. The child's con-

dition was too poor to give adequate irradiation to this enormous recurrent tumor.

Case 3.—H. G., aged thirty-nine years, was admitted to Memorial Hospital on September 17, 1929, with a history of intermittent pain in his left thigh beginning two years ago. Five months ago this pain became constant and severe. An exploratory operation was done at an outside hospital, where an inoperable tumor of the left kidney was found and a specimen removed for examination. The pathologic examination showed a "very cellular, embryonal, Wilms' tumor of the kidney." When first seen he had a slight enlargement of the kidney and a tumor mass attached to the left pelvic wall. This was felt rectally. His hemoglobin was 65 per cent, red blood cells 3,440,000; white blood cells 11,400.

Radiation therapy.—Radium pack; from September 20, 1929, to December 2, 1929 (ten weeks) he had 214,000 millicurie hours at a distance of 15 cm. from four portals of entry. High voltage x-ray from October 3, 1929, to October 21, 1929 (two and one-half weeks) 7,200 r. at a distance of 50 cm. from six portals of entry. On January 21, 1930, his hemoglobin was 80 per cent, red blood cells 4,240,000; white blood cells, 5,200. On February 7, 1930, he had no signs or symptoms of disease and he had gained weight. By June 24, 1930, his pelvic tumor had recurred and become very large. He had tumor nodules in his corpora-cavernosa. Moderate x-ray treatments had no effect upon the pelvic growth. His primary kidney tumor could not be palpated. He developed metastases to the lungs and died October 8, 1930.

Comment.—He had but a moderate irradiation of his primary and secondary tumors.

Case 4.—A. S., aged one year, was admitted to the Memorial Hospital on October 15, 1929, with a history of a mass in his right abdomen at five weeks of age, and hematuria at four months. He was treated by his physician with radium and high voltage x-ray. Following the irradiation the tumor of his kidney almost disappeared. Then it enlarged and when he came to the hospital he showed a bulky movable kidney tumor 10x15 cm. A film of his chest showed a mediastinal tumor mass.

Radiation therapy.—High voltage x-ray between October 15, 1929, and December 31, 1929 (ten weeks). He had seven kidney treatments, four portals of entry at a distance of 50 cm., totaling 4,200 r. and three chest treatments between January 14, 1930, and February 4, 1930, two portals of entry, at a distance of 50 cm.; totaling 1,500 r. The kidney mass did not diminish in size. More high voltage x-ray, between January 31, 1930 and April 29, 1930 (12 weeks). He had eight treatments to his kidneys, three portals of entry, 50 cm. distance, totaling 5,000 r. To his chest between April 4, 1930, and May 20, 1930 (three weeks), he had, at 50 cm. distance, 1,650 r.

His kidney did not diminish in size but a radiograph of his chest showed no tumor. He died August, 1930.

Comment.—I wished to remove the kidney but the parents decided against this. There is a bare possibility that the removal of the kidney might have resulted in a cure as chest metastases cleared up under irradiation. Both the chest and kidney irradiation were inadequate.

Case 5.—E. F., aged three and one-half years, was admitted to Memorial Hospital on May 15, 1930, with a history of constipation beginning in December, 1929. Subsequently a mass appeared in his right abdomen. An incompplete (?) nephrectomy was performed. He was given high voltage x-ray treatment, which improved his condition. The pathologic diagnosis was Wilms' tumor of the kidney. When he came to the hospital he had a tumor mass occupying almost the entire right abdomen. The tumor was painless and fixed.

Radiation therapy.—High voltage x-ray, two portals of entry; 50 cm. distance; from May 15, 1930, to June 24, 1930 (five weeks), nine treatments totaling 5,400 r. The blood counts were as follows: May 13, 1930, hemoglobin 70 per cent, red blood cells 3,720,000, white blood cells 7,900; May 27, 1930, hemoglobin 75 per cent, red blood cells 3,880,000, white blood cells 7,200; July 1, 1930, hemoglobin 70 per cent; red blood cells 4,160,000, white blood cells 5,800. The tumor receded and on July 10, 1930, the child was much better in every way. On July 1, 1930, the child was worse; he had marked ascites, paracenteses several times. He died on July 11, 1930.

Comment.—His x-ray treatment was moderately severe.

Case 6.—M. G., aged four years, was admitted to the Memorial Hospital on July 18, 1931, with a history of attacks of nausea and vomiting for one year. Six weeks ago a mass appeared in left upper abdomen which increased rapidly in size. An exploratory operation was performed and an inoperable kidney tumor found. A piece excised showed a "very cellular malignant tumor, radiosensitive, Wilms' tumor of the kidney."

Radiation therapy.—High voltage x-ray. Between July 18, 1931, and July 20, 1931, she had two treatments; two portals of entry, 70 cm. distance, totaling 740 r. Between July 21, 1931, and August 8, 1931 (two and one-half weeks), she had 1,675 r. in about sixteen treatments. There was entire regression of the tumor. The patient died on December 20, 1931.

Comment.—This was a very inadequate dose of high voltage x-ray. More persistent and adequate x-ray might have controlled this tumor.

Case 7.—M. B., aged four and one-half years, was admitted to the Memorial Hospital on August 18, 1934, with a history of only two weeks of a right sided abdominal swelling. When she came to us she had a kidney tumor extending to the median line and down to

the pelvis. X-rays of the chest, skull, lumbar spine, pelvis and long bones all showed no evidence of metastases. On August 20, 1934, blood count was hemoglobin 50 per cent, red blood cells 2,752,000, white blood cells 11,600.

Radiation therapy.—High voltage x-ray treatment from August 21, 1934, to September 7, 1934 (two and one-half weeks). She had to three portals of entry, anterior, lateral and posterior; 50 cm. distance; 200 r. daily for three doses, then 300 r. daily until she had 4,200 r., total dose. Her kidney reduced markedly in size until it was nearly normal. Blood count on September 24, 1934, was hemoglobin 70 per cent, red blood cells 3,712,000, white blood cells 4,600. She had a blood transfusion on September 27, 1934. On October 19, 1934, a nephrectomy was done. The operation was easily done, no hemorrhage and no shock. The pathologic examination of the removed kidney: "Suppose this is an embryonal carcinoma. Tumor is reduced to necrotic shadow cells. In the midst of remains of the kidney alveoli are occasional anas which resemble degenerated muscle. This points to the tumor having been an embryonal adenosarcoma." She returned home and gained three or four pounds. Then she developed a cough and pain in her right shoulder. She also had some trouble in raising her right arm. She was readmitted on November 12, 1934. An x-ray of her chest revealed fluid in the right lung with evidence of infiltration in the parenchyma of the lung. Her right chest was treated by high voltage x-ray with a diminution of the fluid and in the size of the metastases. She returned home and was readmitted on February 26, 1935, with a twitching of the right arm and right eye starting on the morning of her admission. The following night she died in convulsions. She was diagnosed as having brain metastases. An autopsy showed a "left parietal cerebral metastasis with hemorrhage. Slight radiation fibrosis of the lungs."

Comment.—If operation (nephrectomy) after irradiation of the kidney tumor is the ideal procedure then the result in this patient does not bear this out. A question of much interest, but quite unsolved is: Did the lung and brain metastases occur pre-operatively or did the operation cause these?

Case 8.—M. P., aged two years, was admitted to the Memorial Hospital on November 2, 1932, with a seven weeks history of tonsillitis followed by fever, poor appetite, loss of weight, abdominal discomfort and constipation. Parents noticed an enlarging abdomen and a left sided abdominal mass. No hematuria. About two weeks ago an exploratory operation was done and an inoperable left sided kidney tumor was found. A piece excised showed "a tumor which might be an adrenal neuroblastoma"; does not look like a Wilms' tumor. Cells alone looked very radio-sensitive. She came to the Memorial Hospital two weeks after the operation with a very large kidney tumor extending from the left diaphragm down to the pelvis.

Radiation therapy.—High voltage x-ray, between November 2, 1932, and November 16, 1932 (two weeks). She had 300 r. daily at 50 cm., two portals of entry, anterior and posterior; until she had 2,400 r. Her skin was blistered. There was slight regression of the tumor and her constipation was slightly better. The patient died on January 28, 1933.

Comment.—This probably was not a kidney tumor. It was included in this series because it was believed to be radiosensitive. Her tumor received a good dose of x-ray.

Case 9.—P. F., aged three years, was admitted to the Memorial Hospital on February 5, 1935, with the history of a dull generalized abdominal pain for two months. She was found to have an enlarged right kidney. X-ray of her chest was negative. A nephrectomy was done and a pathologic diagnosis of Wilms' tumor made. She was admitted to the Memorial Hospital with a tense swollen abdomen with several irregular masses felt diffusely throughout the abdomen and some fluid.

Radiation therapy.—High voltage x-ray between February 6, 1935, and March 1, 1935 (three weeks), she had 100 r. daily to four portals of entry, 100 cm. distance while she had 2,300 r. Her abdomen reduced in size and fluid diminished. Her blood count was hemoglobin 70 per cent, red blood cells 3,584,000, white blood cells 15,500. Under treatment her red blood cells remained substantially the same while her white blood cells diminshed. Her abdomen increased in size in one month and she was treated again from April 5, 1935, to April 22, 1935. She had 2,800 r. of high voltage. This had no effect and she died on May 8, 1935.

Comment.—The irradiation was inadequate but was as much as she could stand.

Case 10.—W. W. F., aged two years, was admitted to the Memorial Hospital on August 23, 1935, with a one month's history of protrusion of the umbilicus and an abdominal mass. He was admitted to another hospital and a diagnosis was made of a left sided kidney tumor. He was given six x-ray treatments to the mass. When he came to us his abdomen was markedly distended with the superficial veins visible and enlarged. The entire left and middle abdomen was filled with a firm non-tender mass, the borders of which could not be sharply outlined. On further examination the anterior part of the mass seemed cystic. His blood count showed hemoglobin 85 per cent; red blood cells 4,480,000, white blood cells 8,000. During his stay in the hospital eight blood counts were made. Up to September 16, 1935, his red blood cells never fell below 3,776,000, his hemoglobin never below 75 per cent; but his white blood count dropped immediately to 3,400 and remained around 2,200. The diagnosis was made of a kidney tumor.

Radiation therapy.—High voltage x-ray treatments of the kidney mass were given from August 24, 1935, to September 6, 1935 (two weeks). He had 2,400 r. from three portals of entry at 50 cm. distance, twelve treatments of 200 r. each. The kidney did not recede but the anterior portion became more cystic. Because the mass under the therapeutic x-ray test did not react like a Wilms' tumor and because it was cystic an operation was done on September 24, 1935. An enormous kidney tumor was revealed the anterior portion of which was cystic. It could not be removed so the cystic portion was punctured and straw colored fluid removed. Then the kidney mass was easily removed. There was little shock or reaction. The pathologic report of the removed kidney showed on gross description: "No trace of normal kidney tissue can be seen. Tumor measures 18x18x9 cm., multicystic with two large cysts, 6 cm. and 10 cm. in diameter; smooth walled, bloody contents, with projecting fragments of semi-necrotic tumor tissue. Main tumor mass is polycystic, yellowish, very edematous. Cysts contain serum and mucus and many hemorrhagic points. Those small cysts appear to be different in type from the two larger cysts. The larger cysts are lined by membrane, hyperemia, no areas of solid tumor tissue. Does not suggest ordinary renal carcinoma, suggests an aberrant type of congenital polycystic kidney with tumor formation." Microscopic: "Embryonal adenosarcoma of kidney (radiation changes incomplete with active disease present)." On January 7, 1936, he came back with a local recurrence of the tumor. All this time x-rays of his lungs on several examinations showed no metastases. X-ray treatment of his local recurrence has had little effect. On April 7, 1936, the mass had grown a good deal; the patient was becoming weaker.

Comment.—On looking back over this case, operation at the time it was done was wrong. X-ray treatment should have been continued for a much longer time. The incision into the cysts at the time of operation and the spilling of their contents was the cause of the local recurrence.

SUMMARY

Pre-operative irradiation of kidney tumors marks a great step in the advance of the control of these tumors.

From the case reports compiled from our work and from the literature it would seem that irradiation alone gives better end-results than irradiation followed by nephrectomy.

Irradiation in smaller doses prolonged for a longer period of time would seem to be the method of choice in the control of these tumors.

DISCUSSION

DR. E. G. CRABTREE (Boston, Mass.): I wish to discuss pelvic kidneys in general because within the past three years seven have come into my hands, which indicates some general principles concerning surgery in these kidneys.

In three cases the complaint was hematuria, one due to stone. The remaining two bled from small hydronephroses. Three patients operated on were all infected. These seven cases together with another which occurred in 1929 make a total of eight, of which six were in women, all who had borne children without incident. Two were in men. The age group was twenty-two to seventy. Apparently one can live a normal life with a pelvic kidney. One patient was seen in pregnancy. The pelvic kidney showed the usual hydronephrotic changes due to pregnancy. It was a kidney located in the false pelvis.

Of these eight patients, three were operated on. Certain characteristics of these abnormally placed kidneys are important factors in determining procedure. The absence of any appreciable amount of perirenal fat was noted in two, while it was present in one. This may be a source of trouble, since in pyonephrosis and secondary operations adhesions are formed directly to important structures. I have attempted one secondary operation on such a kidney and failed to remove it. I have seen other surgeons attempt two other cases. Both failed to remove the kidneys. Where a pelvic kidney is diseased removal is the operation of choice if its fellow is not diseased. Secondary operations should be undertaken without optimism. In lone pelvic kidneys I doubt if I should attempt a secondary operation.

I will mention a procedure which was applicable to a very large infected hydronephrosis which contained more than 2,000 c.c. of septic urine. The kidney was exposed transabdominally, opened and drained by a Pessar tube as in cystotomy, through a midline incision. At a secondary operation, the kidney was approached through a Gibson incision and freed from its attachments, and the posterior peritoneum was closed. The kidney was then separated from its drainage attachment to the abdominal wall. By this double operative procedure peritonitis was avoided.

DR. LEON HERMAN (Philadelphia, Pa.): I think we should not lose sight of the fact that Dr. Stevens is reporting instances of single ectopic pelvic kidneys; these are among the rarest of congenital lesions of the upper urinary tract. Dr. Crabtree's remarks refer to unilateral ectopic pelvic kidneys, which are quite a different matter. Single unilateral ectopia is relatively common. The cases which I wish to show are of this type. They occupy either the false or the true pelvis, the latter being the more important from the surgical standpoint. In some instances part of the kidney is contained in the false, the other portion in the true pelvis. (Slides) This first slide shows such a condition. This individual complained of abdominal pain but we did not feel justified in removing the kidney, which was normal in function. The next slide is of a typical pelvic kidney which was likewise normal in function and nothing was done about it. The next slide illustrates a case admitted to the Pennsylvania Hospital with a diagnosis of appendiceal abscess. The abdomen was opened and it was found that this patient had an ectopic kidney which was the seat of acute pyelonephritis. This patient was treated palliatively and has remained clinically well. The next case is one of hydronephrosis due to calculus in a pelvic kidney. The roentgenogram indicated vesical calculus. As the drawing shows, the pelvis pointed forward and the organ was vascularized by several renal arteries from the adjacent iliacs. In most cases these kidneys, as Dr. Stevens has pointed out, have a bilateral blood supply.

The next slide will probably interest Dr. Barringer. It illustrates a hypernephroma of the kidney which was subjected to deep x-ray therapy for a period of seven weeks before operation. The tumor was said to have diminished in size and then to have increased. The patient was treated by a roentgenologist and had had no urologic opinion prior to his admission to our service. It will be observed that this tumor is very nodular, the nodules being of the typical yellowish color of hypernephroma and separated by large white strands of connective tissue. The changes are in all probability the result of deep x-ray therapy.

DR. BARRINGER: How long afterwards was it taken out?

DR. HERMAN: Almost immediately; certainly, within a month. In conclusion, I would like to say that deep x-ray therapy in

this case complicated the surgery and post-operative healing of the wound considerably. In this particular case there was x-ray vascularization of all the tissues, including the abdominal wall, and a sinus persists through the exceedingly rigid tissues.

DR. EDWARD L. KEYES (New York, N. Y.): Reaction to irradiation is most important. We have found, by the way, that the small dose (the so-called Coutard method, given in even smaller doses than Dr. Barringer has used) of about 100 r. daily six days a week for a couple of months perhaps, gives less general reaction to the patient than do any of the stronger methods. The general reaction can be minimized by the administration of liver extract.

In the second place, Dr. McLellan, who has a very light hand, has found that two or three injections of mild solutions of acriflavine, about one to 4,000 or 5,000 given through a very small catheter, seem markedly to diminish the bladder irritation by x-ray treatment of bladder tumors.

Dr. Barringer, why not aspiration biopsy? One of our continued difficulties is going to be differences on the subject of aspiration biopsy both as to its accuracy and as to the harm it may or may not do. I thought in your establishment up town that aspiration biopsies were done preferably bimanually and simultaneously, as it were, on all patients with all diseases.

DR. HENRY O. MERTZ (Indianapolis, Ind.): In connection with Dr. Stevens' report, while we have not had a congenitally single dystopic kidney with our series of unilateral renal dystopia, we have had three instances of symmetrically placed bilateral ectopic kidneys. In one instance the kidneys were located opposite the lumbosacral articulation; in the second case they were resting upon the sacral promontory, and in the third instance they were in the pelvis proper. In all cases of ectopic kidney we have been employing the lateral pyelogram as a routine procedure. But one of our patients with bilateral dystopia has been operated on. Here the kidneys were fused and nephrectomy was impossible.

Lateral pyelography has been done in these bilateral cases with the hope that we might secure some information that would help us in determining clinically whether a fusion existed or not. We do not have sufficient data to be of any help to us as yet. In uni-

lateral dystopia, however, varying degrees of rotation of the kidneys have been demonstrated on the film. While in most cases the hilum of the kidney is directed anteriorly, yet in one instance we found a dystopic kidney lying in the pelvis with the hilum of the kidney directed posteriorly toward the sacrum.

We feel that the information secured by lateral pyelography may be of value when surgery is contemplated upon the pelvic kidney and would recommend it to you as a routine procedure until sufficient information has been secured to justify conclusions as to its real worth.

DR. ARCHIE L. DEAN, JR. (New York, N. Y.): In considering irradiation of any tumor, I think the first point is whether or not we can deliver an effective dose of radiation to that portion of the body. After measuring cross sections of cadavers and localizing roentgenograms of renal tumors and knowing the depth dose of high voltage roentgen rays, we computed that five threshold erythemas could be delivered to the region of a kidney tumor. This is effective radiation on radiosensitive tumors.

The next point is the sensitivity of the tumor to radiation. Considering all renal tumors, there is a tremendous difference. At one extreme there is the epithelial tumor of the renal pelvis, which is radio-resistant. In these cases, I do not recommend radiation either before or after operation.

At the next extreme are the embryonal Wilms' tumors, which are highly radio-sensitive and will rapidly shrink after comparatively small doses of radiation. In these cases I think pre-operative irradiation should always be practiced. In between there are the tumors of the renal parenchyma in adults, in which there is a considerable difference of radio-sensitivity. We have no test except the therapeutic one which will determine whether or not an individual tumor is radio-sensitive. Therefore, if the tumor is large, I think it should be radiated before operation. If it diminishes in size, radiation should be continued until the maximal regression is obtained. If there is no regression promptly, I should say within two weeks, radiation should be stopped and nephrectomy performed.

As far as we know, after an experience of only a year and a half with a total of fifteen cases, there is no danger in the aspiration biopsy of kidneys suspected of harboring tumors. Unfortu-

nately, the information which can be obtained by aspiration biopsy in these cases is limited. Experienced pathologists can tell us whether or not we are dealing with a tumor, but not whether the tumor will prove radio-sensitive or not. The time to remove a tumor following irradiation is important. At the present inadequate state of our knowledge, it appears safer to expect nothing more than regression in size, although that can be appreciable. One cannot expect to devitalize the last tumor cell. After a tumor has regressed so that it can hardly be felt or we think it is about the size of a normal kidney, nephrectomy is easy and there is nothing more to be gained by waiting. In the sensitive Wilms' tumors, this regression will take place perhaps in two to three weeks. In the more radio-resistant tumors in adults, the regression may not take place until four to six weeks have passed, but I think that delay should not be greater than that. If the delay is too great in a radio-sensitive tumor, since they are highly malignant as well, recurrence will be prompt. I have seen tumors which rapidly shrank after irradiation, regain their original large size in two weeks.

Dr. A. R. Stevens (New York, N. Y.): The general topic of pelvic kidneys may lead one into so many corners that I thought it better (to keep the paper within any decent length) to confine myself to "single pelvic kidneys." One has the distinct surgical problem of trying to do something to a kidney badly located, which even so stands alone as the patient's only defense.

These ectopic kidneys that are placed higher up, in the iliac region, one can get at more easily, and one is not hampered by a bilateral blood supply, usual in pelvic kidneys. In our particular case, we were very fortunate in finding a single blood supply and were able to get the kidney well up in the wound where it could be manipulated.

The only patients really helped by operation in the tabulated group of twenty-five were one case of nephrostomy which Dr. Nesbitt reported in discussion, and one of lithotomy by Tachio. The latter approached the kidney through a transperitoneal operation, and had the ill luck to draw a permanent urinary fistula.

Dr. Alexander Randall (Philadelphia, Pa.): May I ask Dr. Barringer a question? In the opinion of yourself and your

group, to whom we all look for information, is the effect of irradiation upon the tumor entirely secondary to an ischemia, or are there other factors that cause it?

DR. BENJAMIN S. BARRINGER (New York, N. Y.): In answering Dr. Randall's question first, I don't believe we precisely know. We originally thought that there were two effects of irradiation, first upon the cells primarily and second upon the blood vessels. We are not sure about that blood vessel effect. We still must stay with it because we haven't worked that out yet. It is probably a factor.

My purpose in bringing this subject before you was to inform you of quite a change of heart that I underwent in beginning to realize that irradiation followed by nephrectomy was not giving as brilliant results as we hoped it would give. The life span of the patients so treated has not been apparently much lengthened. They still get metastases; either the metastases were there before the nephrectomy or are caused by the nephrectomy, but the fact remains that the results are quite disappointing to me. There are cases which under irradiation alone have progressed well (I found one patient well five years; Dr. Sisk has reported a patient who under irradiation alone has remained well seven or eight years) and this in the light that most of the previous irradiation, I believe, has been rather inadequately given. It has not been the best type of irradiation. Each six months we change because we are trying to get something a little better. With more adequate irradiation, I should hope, rather differing from Dr. Dean (we always love to differ, that is what makes our service very stimulating), that we may be able to produce better results. I should like to stick to irradiation alone to see what we can do.

In answer to Dr. Keyes, I have no doubt liver extract does help these patients, but queerly enough the red blood cells, as a rule, have remained normal in these children. It is the white blood cells that give us the trouble; when they drop down to 2,000 or 3,000, then we have to stop irradiation. I am not sure that the liver extract stimulates the white blood cells.

Aspiration biopsy, I think, might be tried in these cases, although I have not done it routinely.

TUBERCULOSIS IN THE FUSED KIDNEY

REPORT OF A CASE

WILLIAM E. LOWER, M.D.

From the Cleveland Clinic, Cleveland, Ohio

The incidence of fused kidneys is probably about one to every four or five hundred patients examined. It is generally conceded that fused kidneys are more susceptible to pathologic conditions than separate kidneys and Rathbun,[2] in his review of 108 cases of horseshoe kidneys, found the following conditions to be most common: calculi, hydronephrosis, pyonephrosis, tuberculosis, neoplasm, polycystic kidneys, nephritis, and ureteral calculi.

Tuberculosis of the fused kidney, a case of which I wish to present today, is not so uncommon but it is one of the less frequent complications of this anomaly.

The report of this case was included in a paper[1] presented at the Southeastern Branch of the American Urological Association in Nashville, December 7, 1935, but at that time the true nature of the lesion had not been determined.

This case is of interest because of the following unusual features: (1) three separate pelves were present, which meant really a fusion of three kidneys; (2) tuberculosis was present in the middle portion or the isthmus; and (3) the lesion was found in an unusual location of the specimen examined.

REPORT OF CASE

The patient was a woman, thirty-six years of age, whose chief complaints were of pain in the right side, in the epigastrium and lower right back, and also of some frequency of urination. There had been loss of appetite and loss of weight. She stated that about one year previous to this examination she had begun to have more or less continuous, dull aching pain, in the right side of the back in the region of the costovertebral angle and in the anterior part of the abdomen just above the umbilicus. At times, there had been pain under the right costal margin. The pain seemed to be most severe while the patient was in the prone position; it disturbed her sleep greatly and a sedative was usually taken at bedtime. During the previous three months, the pain had become definitely more severe and had localized to an area above the umbilicus, radiating toward the anterior superior

spine on the right ilium. Recently, the pain had been more severe on frequent occasions, and during the preceding three months the additional symptoms of frequency, nocturia, and dysuria had developed. These were most pronounced during the attacks of severe pain and the nocturia persisted two or three nights following the attack. The dysuria was not severe but uncomfortable. At times, marked pyuria was present but there never had been gross hematuria. The patient complained of mild nausea at times which was not associated

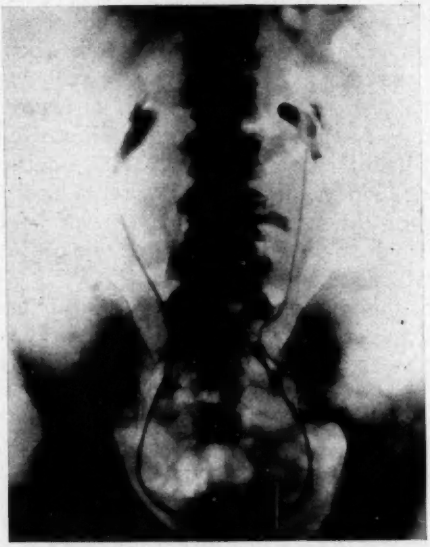

Fig. 1. Bilateral pyelogram made preoperatively.

with vomiting. Increasing anorexia developed which was associated with a loss of 10 or 12 pounds in weight during a period of four weeks. The patient was troubled with mild constipation but no abnormality was noted in the stools. Some upper respiratory difficulty during the summer months which simulated hay fever and an allergic reaction to certain foods such as olives had been noticed. Menstruation began at the age of fourteen years and the menses were always irregular and scanty. An artificial menopause occurred in 1920, fifteen years before this examination. Nothing of significance was revealed in the past history except that an operation had been performed in 1920 which included appendectomy, bilateral salpingectomy and partial oöphrectomy.

Physical examination revealed a well developed and nourished white woman who weighed 119 pounds. The blood pressure was 136 systolic and 76 diastolic; the temperature was 98.6° F., the pulse was 112, and the respirations were 20. Above and to the right of the umbilicus, there was considerable tenderness, some muscular rigidity and suggestive evidence of a mass. No other abnormalities were discovered.

Repeated examinations of the blood showed a marked anemia and

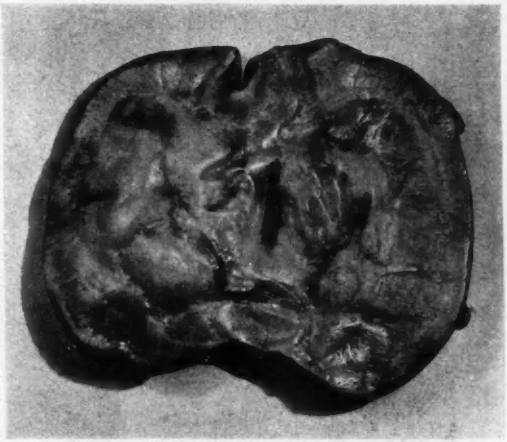

Fig. 2. Photograph of specimen.

the hemoglobin varied from 52 to 70 per cent. The blood urea was 27 mg. per 100 c.c., blood sugar 75 mg. per 100 c.c., and the urea clearance was 54 and 73 per cent. Successive urinalyses showed a slight trace of albumin, numerous pus cells, and an occasional red blood cell. No tubercle bacilli were found in the urine. Cultures of specimens of urine from the kidneys gave negative findings.

Cystoscopic examination showed no abnormality in the bladder. Catheters were passed well up to the kidney pelves and a bilateral pyelogram was made (Fig. 1). This showed rotation of the right kidney with the catheter far out. The left ureter branched at the sacro-iliac joint and the outer one went to the left kidney. This kidney pelvis and ureter were not entirely filled. The other branch of the ureter went to a kidney in the midline and it showed some hydronephrosis. Roentgen examination gave the impression that the left and mid-kidney probably were fused. An intravenous urogram showed a normal right kidney pelvis with the exception of rotation

on the long axis. There was prompt function from both sides and also from an ectopic kidney in the middle of the lower part of the abdomen. The left kidney showed a normal pelvis. We were unable to determine the presence of fusion of these kidneys.

Roentgen examination of the stomach, gallbladder, and colon showed no abnormalities.

Operation was performed under spinal anesthesia. The perirenal space was exposed through a left oblique incision. A fused kidney

Fig. 3. Intravenous urogram made postoperatively.

was found which was made up of three almost distinct kidneys. The two normally placed kidneys were connected by another kidney which was lying in the midline with a complete pelvis and ureter, the ureter anastomosing with that of the left kidney at about its middle third. The anomalous kidney and ureter was resected (Fig. 2).

Microscopic examination of the removed specimen showed no active inflammation in the pelvis. In the ureter, adjacent to the pelvis, there was a small, localized area in which several hyperplastic tubercles were present with an occasional giant cell. There was no caseation. There was a slight amount of lymphoid infiltration around the tubercles.

The pathologic diagnosis was tuberculosis of an anomalous ureter.

The patient made an uneventful convalescence. An intravenous urogram made postoperatively showed both right and left kidneys to be functioning well (Fig. 3). They filled promptly but emptied rather slowly as some dye remained after one hour.

A casual review of the literature shows that twenty-three cases of tuberculosis of a horseshoe kidney have been reported.

Before the advent of modern roentgenologic diagnostic methods, few clinical diagnoses of horseshoe kidneys were made and only in very thin patients in whom the lower poles of the kidney could be palpated as they converged toward or at the midline. In a few cases, the isthmus could be palpated over the aorta. Of the small number of cases of tuberculosis reported in the literature, eleven diagnoses were made at the time of operation, two clinical diagnoses were made and two were made by roentgen examination.

The symptoms, methods of diagnosis and treatment of fused kidneys have been discussed in the paper previously mentioned.[1]

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FACTORS FAVORING NON-PROGRESSION OF CERTAIN TUBERCULOUS LESIONS OF THE GENITO-URINARY TRACT

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Tuberculosis, unlike any other disease which may require surgical intervention, is not, from its earliest stages, localized entirely to the organ at the moment presenting symptoms. It is a constitutional disease presenting local manifestations in various organs. A lesion in the genito-urinary system is invariably secondary and may be a tertiary focus. The surgical extirpation of this lesion does not remove all of the tuberculosis from the genito-urinary tract and in no way affects the primary or other secondary foci except indirectly by relieving the patient of one area of disease. In this paper we discuss some of the factors that must be considered during the surgical and non-surgical treatment and that induce non-progression or possible healing of local tuberculous lesions in the genito-urinary system.

CONSTITUTIONAL TREATMENT

Years of experience in the treatment of tuberculosis of all types has disclosed that patients who do not possess or develop that indefinable something which we choose to call "resistance against tuberculosis" do not recover from the disease in spite of all methods of treatment, even though the original lesion is a minimal one. Probably no one factor contributes more toward improving a patient's general condition and his chances of properly handling the tuberculous process present than bed rest and a comprehensive hygienic regimen. A striking demonstration of the effect of such treatment is made by the rapid improvement in general condition and symptoms, which follows the application of intensive bed rest for patients with extensive pulmonary tuberculosis, who previously had been losing ground or whose symptoms were increasing. Similar improvement in general and local symptoms has been observed during constitutional treatment utilized alone or in combination with local surgical treatment for various extrapulmonary tuberculous lesions. The most notable examples of improvement with this

type of therapy have occurred with tuberculosis of bones and joints. Here the presence of deformity or the undesirability of weight bearing has rendered constitutional treatment and bed rest mandatory. The trend in this field has been so strongly in favor of constitutional treatment that necessary surgical treatment has at times been neglected.

Urologists, as a group, have been slow to take advantage of the benefits to be gained by supplementary constitutional treatment. In our sanatorium practice repeated instances have been observed wherein patients under intensive constitutional treatment for other tuberculous conditions, which at the time precluded any surgical trauma, have experienced marked amelioration or even complete cessation of genito-urinary symptoms. This has followed the institution of constitutional treatment for patients suffering with uncontrollable vesical tuberculosis subsequent to nephrectomy. The following case history exemplifies this.

Mrs. E. B., aged thirty years, was admitted to Glen Lake Sanatorium on May 16, 1930. One year previous to admission she complained of urinary frequency, dysuria and nocturia. She was given palliative treatment without examination and without relief from symptoms. A correct urinary tract diagnosis was not made until nine months later, when tuberculosis of the right kidney and bladder was recognized and immediate nephrectomy performed. Six months following nephrectomy and at admission to the Sanatorium, the general condition of the patient improved and symptoms decreased, but some bladder irritability, nocturia and a draining sinus at the site of her nephrectomy wound persisted. Roentgenograms of the chest revealed no pulmonary lesion. The urine contained albumin, pus and tubercle bacilli. There was cystoscopic evidence of a residual cystitis, and tubercle bacilli were recovered from the urine obtained by a ureteral catheter from the remaining, or left, kidney. A retrograde pyelogram revealed a filling defect interpreted as a destructive type of tuberculosis involving the left renal cortex. Under intensive constitutional treatment for tuberculosis, supplemented by heliotherapy, the patient's dysuria ceased, urinary frequency approached normal, the draining sinus in the flank healed, and she gained twenty-one pounds in weight. This patient was discharged October 22, 1931, seventeen months after admission, and was advised to continue home treatment and heliotherapy. Six months later, April 1, 1932, she was readmitted, complaining of recurrence of frequency, nocturia and dysuria, and now accompanied by fever. All of these symptoms appeared following an acute upper respiratory infection. Examination revealed normal kidney function, but the urine contained albumin, pus, red blood

cells, tubercle bacilli and streptococci. A partial ureteral obstruction was encountered in the left ureter, through which a ureteral catheter would not pass. An intravenous urogram revealed a dilated kidney pelvis and calices and a dilated ureter, with evidence of a partial obstruction near the uretero-vesical junction. A severe reaction immediately followed this attempt at ureteral catheterization, and symptoms of toxemia, diminishing kidney function and a rather severe secondary anemia persisted. This patient's condition became bad but under a program of intensive bed rest, heliotherapy, avoidance of all local trauma, the application of heat to the pelvis by means of hot douches and Sitz baths, and active treatment for the anemia, her general condition improved, the bladder symptoms disappeared, the temperature returned to normal and the kidney function improved. She was discharged from the Sanatorium on April 25, 1934, two years following her second admission. She was advised to continue home treatment and heliotherapy. While the eventual prognosis is not good, this patient's general condition has been improved, she has been rendered much more comfortable and unquestionably her life has been prolonged. Two years after discharge she continues in approximately the same condition as at the time of her discharge.

An unusual effect of constitutional treatment on a tuberculous lesion in the kidney, even beyond anyone's greatest expectations, occurred during the treatment of Mrs. E. H.

Mrs. E. H. was thirty-two years of age when admitted to Glen Lake Sanatorium on June 7, 1926. She had a far advanced bilateral pulmonary tuberculosis of a bronchogenic miliary type with cavitation in the right apex. The uterus was as large as a seven months' pregnancy. On admission, the patient complained of some urinary frequency which improved following the normal birth of a normal baby. Leukocytes persisted in the urine so that a urologic examination was made. Tubercle bacilli were recovered (by means of guinea pig inoculations) from the urine obtained through the left ureteral catheter. Retrograde pyelograms revealed a filling defect of a very small destructive lesion in this side. Improvement in the patient's general condition followed constitutional treatment so that the pulmonary tuberculosis became arrested, urinary symptoms disappeared completely and tubercle bacilli could no longer be recovered from the urine. Subsequently there was no pyelographic evidence of change in the small destructive lesion previously demonstrated. The patient was discharged from the institution in April, 1929, two years and ten months following admission, without symptoms, and has remained in good condition to date. Subsequent periodic reëxamination of the filling defect found in the pyelogram has shown no change since 1929. We have been unable to demonstrate tubercle bacilli in the ureteral or bladder urine by guinea pig inoculation since February, 1929, although

repeated examinations have been made. The patient does her own housework, and over a period of seven years her general condition has continued good with no recurrence of urinary symptoms or find-

We wish to repeat again a statement we have made before and that is "that the progress of a destructive tuberculous lesion in the kidney in a patient of good general resistance is usually not rapid and is frequently a very slow process." Recognition of this behavior of tuberculosis in the urinary tract by the physician treating such conditions should give him additional assurance so that a thorough survey of the patient and an accurate diagnosis of the local conditions may be made before proceeding with surgical treatment, which has sometimes been hurried and ill-advised.

The kidney of M. E., a patient at the Sanatorium, illustrated the extremely slow progress of a tuberculous renal lesion in a patient with good resistance against tuberculosis. In this instance, after fourteen years of recognized tuberculosis in this kidney, the maximum diameter of the tuberculous parenchymal abscess did not exceed one centimeter.

The duration of life in certain patients with bilateral destructive renal tuberculosis and in others with tuberculous involvement of a single kidney which followed a nephrectomy illustrates the slow progress which may occur. Survival for ten or fifteen years or more with these complicated lesions has been observed by us in certain isolated instances. Certainly there is now enough evidence at hand to justify the intensive use of all such measures as may prolong the life and add to the comfort of those unfortunates whose tuberculosis is so situated that it is not amenable to surgical extirpation.

HELIOTHERAPY

The beneficent effect of heliotherapy or actinotherapy on extrapulmonary tuberculous lesions, particularly of the osseous and lymphatic systems, has long been recognized and widely, and at times unwisely, used. While its exact mechanism of action is not clearly understood, the effects produced are so manifest as to leave no real doubt as to their occurrence. Granulating wounds under the influence of actinic light or sun become cleaner and seem to heal more readily than without such treatment. Whether this effect be due to a local antiseptic action of the actinic light or to drying or heating, or to a stimulating action on the granulating tissue,

is of less importance than the improved healing which results. The effect of heliotherapy on deep-seated lesions is less readily understood, for it is well known that the penetration of the light waves in the effective portion of the spectrum is rather slight, yet general improvement accompanies and follows its use. Whether the action be tonic or specific, its effect becomes apparent in improved general condition and favorable changes in the local manifestations of the disease. Like any other therapeutic agent, it must be used with discretion and overdosage must be avoided. It is an accessory therapeutic measure, not a cure-all, and patients must not be sacrificed merely to obtain it. It is as illogical to require a tuberculous patient to travel miles daily to a doctor's office for lamp treatment as it would be to expect a man with a broken leg to walk the same distance daily for massage. The effect of heliotherapy cannot be separated from the effect of constitutional treatment and associated increase in resistance against tuberculosis, but that heliotherapy has some value is beyond doubt.

The effect produced by this regime is exemplified in the following case report:

Mrs. M. S., aged forty-two, was admitted to the Sanatorium on October 30, 1924, with pulmonary spinal and renal tuberculosis, chronic cholecystitis and chronic arthritis. Under a regime of constitutional treatment and heliotherapy the pulmonary and bone lesions became arrested, the patient's general condition and bladder symptoms improved and tubercle bacilli disappeared from the urine. When the rest of her tuberculosis was controlled and her general condition was satisfactory, a nephrectomy was performed because of a known, unilateral, destructive renal lesion. This patient had ureteral colic produced by a tuberculous process in the ureter and nephrectomy was done, even though her urine, over a period of two years, contained no tubercle bacilli. The tuberculous abscess in the upper pole of this kidney was not healed, was encapsulated, and was shut off from the renal pelvis by a thick, fibrous wall so that for a period of two years it had not drained into the kidney pelvis. This patient continues in good condition to this date.

TREATMENT OF OTHER FOCI OF TUBERCULOSIS

No patient presenting a tuberculous lesion of any type can be fairly treated unless a thorough survey is made for other conditions and for other foci of tuberculosis. The problem of properly treating a patient in good general condition who presents a uni-

lateral, destructive, renal tuberculous focus with no evidence of other tuberculosis clinically recognizable is a relatively simple one. Nephrectomy should be performed without delay.

On the other hand, the patient who exhibits another or several other foci of tuberculosis presents a therapeutic problem which at times may tax the ingenuity of even the most experienced. Except in emergency, greatest consideration should always be given to those lesions potentially the most dangerous to the patient's life and most likely to spread under strain; not overlooking, of course, the patient's comfort and well-being.

Pulmonary tuberculosis, by all odds, presents the greatest menace to life and is much more readily reactivated or spread following any trauma than is any type of extrapulmonary lesion. In the presence of an active pulmonary process, elective surgery should be postponed until the pulmonary lesion is at least quiescent. Emergency surgery, of course, must be performed in spite of this, but it should be done in such a way that there is a minimum of trauma to the lungs. Local or spinal anesthesia must be used if at all feasible. Intensive constitutional treatment should be applied postoperatively to insure against any exacerbation of the pulmonary lesion and to control any spread which may have occurred. The adequate treatment of other extrapulmonary tuberculous foci, if this may be accomplished without trauma sufficient to lower the patient's resistance to any considerable degree, will improve his chances of handling his residual pulmonary tuberculosis.

As mentioned above, the progress of a destructive renal tuberculous lesion is relatively slow and, when unaccompanied by ureteral obstruction, sepsis or hemorrhage, adequate time may always be taken for complete diagnosis and for the treatment of other more important foci, particularly pulmonary, without jeopardizing the patient's life or chances of recovery. The following case reports are examples.

Miss G. B., aged thirty-six years, was admitted to the Sanatorium on August 7, 1928, with far advanced pulmonary, renal and ischiorectal tuberculosis and tuberculosis of the ear. The pulmonary lesion was unilateral, accompanied by a large apical cavity which was not controlled by an extensive artificial pneumothorax. Pulmonary hemorrhage had occurred shortly before admission. The urine revealed pus, red blood cells and tubercle bacilli which were recovered following guinea pig inoculation but not on smear. The patient's urinary

symptoms were slight urinary frequency and discomfort in the right flank. These had not increased over a period of two and one-half years. Renal function was normal. There was pyelographic evidence of destructive tuberculosis in the right kidney. The left kidney showed no abnormalities. This patient's pulmonary tuberculosis was treated in the usual manner, supplemented by complete extrapleural thoracoplasty and phrenic exeresis. The ischiorectal tuberculosis was relieved by surgical drainage and the tuberculosis of the ear by local treatment and heliotherapy. A severe secondary anemia responded to liver and iron therapy. The pyelograms revealed slight progression of the right renal lesion during two and one-half years. A right nephrectomy and ureterectomy were performed in March, 1931. The patient was discharged from the Sanatorium on July 30, 1932, a little less than four years after admission, with all tuberculous lesions arrested. She has continued her work as a teacher since that time with no recurrence of trouble and no symptoms.

* * *

Miss M. S., aged twenty-six years, was admitted to the Sanatorium, April 10, 1919, with pulmonary tuberculosis (far advanced), tuberculosis of the third, fourth and fifth lumbar vertebræ, tuberculous salpingitis and peritonitis, ureteral calculi and bilateral renal tuberculosis. Under intensive bed rest and constitutional treatment, the pulmonary and spine lesions became arrested. A psoas abscess was drained and eventually healed. The ureteral calculi were passed following ureteral manipulation. Pus and tubercle bacilli were recovered from the urine obtained from both renal pelves. Retrograde pyelograms revealed filling defects characteristic of destructive tuberculosis of both kidneys. Following a laparotomy and double salpingectomy, all bladder symptoms disappeared. The patient has been discharged from the Sanatorium for eleven years and has been working for ten years.

A recent complete examination revealed the pulmonary and spine lesions apparently healed, and an extensive area of calcification in the region of the right kidney. The left pyelo-ureterogram was apparently normal. The right revealed changes in the pelvic outline observed eleven years before. These were obliterations of the upper calices in the region of the kidney where the recent urogram revealed numerous deposits of calcium. Kidney function was normal. The urine contained no pus. Specimens of urine obtained from the bladder and kidney pelves were negative for tubercle bacilli, both microscopically and on guinea pig inoculation. The patient presented a hypertension of 230/140 mm. of mercury, which, to date, has remained unexplained.

The following case report is an example of the way genito-urinary tuberculosis should not be, but is, frequently, treated:

Mr. O. S., forty-three years of age, was admitted October 9, 1929, complaining of weakness, night sweats and loss of weight. The past history contained the following data: Six years previously he had developed urinary frequency and nocturia and was examined by a physician, but no cause for his complaints was found. Two years later, because of persistence of the symptoms and the addition of burning urination, he was again examined and a diagnosis of tuberculosis of the right kidney made. Nephrectomy was immediately performed. The history contains no notes about pulmonary lesions or a search having been made for them, or for other tuberculous lesions. The patient returned to his work within three months. Two years later he developed a swelling in the left side of the scrotum, which increased rapidly. Two weeks following his return for examination, a left epididymo-orchidectomy was performed, and the tissue removed was identified as tuberculous. The patient again returned to work in less than a month. Two years later he noticed a swelling in the right side of the scrotum. He consulted a physician, who performed an epididymectomy one week later, the process again being tuberculous. The patient again returned to work within a short period of time but within three months was forced to give up his work because of weakness, night sweats, and loss of weight and the presence of pain in the region of the lumbosacral and sacro-iliac joint on the left side. Upon admission he presented a pulmonary tuberculosis but no evidence of tuberculosis in the contralateral kidney. Under constitutional treatment and heliotherapy his general condition improved, his symptoms subsided and he became able to work. Three years later he was still carrying on and in good condition.

HEAT

It has been conclusively proven, both experimentally and clinically, that it is impossible to maintain temperatures in the human body which will either kill or materially harm the tubercle bacillus, without, at the same time, damaging the tissues. However, there are a few places in the treatment of genito-urinary tuberculosis wherein the use of heat seems to be of distinct benefit. During the acute stages of tuberculous epididymitis the use of hot applications or Sitz baths is a distinct aid in alleviating pain and reducing swelling. After the formation and drainage of an abscess of the epididymis, the use of heat seems to favor the more rapid absorption of the inflammatory exudate. The use of hot Sitz baths is of value in the treatment of prostatic or vesical tuberculosis, if the patient's general condition will permit. Heat will alleviate the pain and discomfort in patients presenting tenesmus and other distressing bladder symptoms.

DRAINAGE OF ABSCESSES

Tuberculous abscesses, like those of other etiologic conditions, respond favorably to evacuation of the pus, but in the drainage and subsequent handling of these abscesses, it is particularly important that secondary infection be avoided. If this occurs, the local reaction is unfavorable and results in more rapid formation of secretion and more marked toxic absorption by the patient.

Aspiration or incision and drainage of the abscess of tuberculous epididymitis is usually followed by prompt improvement in the local condition, the inflammation quiets down promptly and the discharge gradually thins out until it is watery in character. Tuberculous abscesses of the prostate frequently drain into the prostatic urethra either through the prostatic ducts or in the region of the prostatic duct openings. This is one of the factors that contributes to the relatively benign nature of this condition. In those instances in which prostatic tuberculous abscesses progress peripherally and rupture into the rectum, secondary infection follows, rendering the prognosis much less favorable. The periprostatic abscess may also burrow its way in various other directions, rendering the patient very miserable. The following is a case report of this condition:

Mr. R. T., colored, aged thirty-four, was admitted to the Sanatorium on August 3, 1929, with bilateral pulmonary tuberculosis and cavitation, a right tuberculous pyonephrosis, a functionless left kidney, tuberculosis of the prostate, tuberculosis of both epididymi, and an old tuberculosis of the right knee. Under constitutional treatment his pulmonary condition improved. His urinary condition progressed favorably for a time until he developed pain in the lower abdominal and inguinal areas, followed by the appearance of an induration in the right inguinal region. This was a periprostatic abscess which gradually softened and finally discharged pus and urine containing tubercle bacilli. Following this drainage, the patient's general condition improved steadily, his temperature returned to normal and his renal function increased. Under a regimen of bed rest and heliotherapy, his pulmonary tuberculosis continued to improve. The inguinal sinus healed and his urinary symptoms diminished up to the time of his discharge in 1933. When examined recently (in 1936), two and one-half years later, his general condition was good; his pulmonary lesion was quiescent; and his urinary symptoms continue the same as when discharged from the Sanatorium; however, he is able to do light work. The urine obtained at this time contained pus and albumin but no tubercle bacilli were found after the urine had been injected into

guinea pigs. This young man's ultimate prognosis is essentially very unfavorable. All that we expected to accomplish was to prolong his life and add to his comfort, and this has been accomplished.

A perinephritic abscess, tuberculous or non-tuberculous, occurring in a patient with genito-urinary tuberculosis demands immedate surgical drainage of this accumulation of pus. The drainage of this or like accumulations of pus from patients presenting apparently hopeless prognoses may be followed by improvement which is nothing short of miraculous. Patients in very poor general condition require drainage of the abscess only. Nephrectomy in the presence of such a complication is a difficult procedure attended by considerable risk and should not be attempted. The kidney producing, or associated with, perinephritic abscess is, at times, totally destroyed, and is really a part of the abscess cavity itself, so that drainage of the accumulation of pus may accomplish as much as nephrectomy. The following case report will illustrate the almost incredible result of such a drainage operation:

Mr. H. M., colored, aged thirty-eight years, was admitted on May 9, 1932, with tuberculosis of the prostate and both epididymi, functionless and tuberculous right kidney, questionable perinephritic tuberculous abscess surrounding the left kidney, and a urethral stricture. He had no active pulmonary tuberculosis. A suprapubic cystostomy was made in July, 1932, because of urethral obstruction from a urethral stricture and tuberculosis of the prostate. In November, 1932, the patient was extremely emaciated with a very high temperature, and was so ill that we were afraid to add surgical trauma to his present heavy load. However, we discovered a right perinephritic abscess which had to be drained of a large amount of pus from several pockets. Following this a decided improvement in his condition resulted so that constitutional treatment and heliotherapy could be started again. In all he gained 67 pounds in weight. The prostatic infection subsided (which relieved enough of the urethral obstruction so that the patient could urinate), and eventually the suprapubic wound and the drainage site in the right flank healed. He was discharged on May 31, 1934, two years after admission, returned to work and has remained in good general condition. A subsequent right nephrectomy was not necessary as this kidney had been destroyed and its residue extruded at the time of the drainage of the perinephritic abscess.

Ureteral occlusion associated with renal tuberculosis, particularly in the presence of secondary infection, may be followed by sepsis and the development of a condition which is equally as serious as that of a perinephritic abscess. Here the abscess is confined

to the kidney itself so that nephrectomy, even in the presence of bilateral renal tuberculosis, is justifiable as an emergency procedure. Marked improvement in general condition may follow the institution of such therapy.

CAUTERY

Cautery now occupies a far less important place in all surgical treatment than it did years ago. While, in general, clean surgical excision of tuberculous tissue is to be preferred, occasions will arise in dealing with tuberculous sinuses when coagulation of tissue by galvano-cautery or the coagulating current of the endotherm may be used to advantage. Residual tuberculous ulcers of the bladder that bleed and that have not healed within a reasonable time following nephrectomy and the treatment of other tuberculosis, may be treated by superficial coagulation with the endotherm. This will relieve the patient of vesical symptoms and bleeding.

THE AVOIDANCE OF TRAUMA AND SECONDARY INFECTION

The traumatization of any tuberculous focus may produce an unfavorable local reaction and may result in the metastasis of tubercle bacilli from this area. It is our aim to avoid all unnecessary manipulation of or about a tuberculous focus and to utilize extreme gentleness when manipulation is necessary. Cystoscopy and ureteral catheterization may be done when necessary to determine completely the pathologic conditions present. This must be done gently, avoiding all possible trauma. The use of sacral or spinal anesthesia during cystoscopy permits a more thorough and a painless examination as well as a more gentle one, because of the relaxation afforded. Traumatization of the prostate, prostatic urethra and the bladder by the cystoscope, overdistention of the bladder by the dilating medium, injury to the tortuous ureter by forceful attempts at catheterization, and overdistention of the renal pelvis by the pyelographic media, all cause the patient subsequent distress which may react unfavorably on the progress of the tuberculosis present. Massage of the prostate or seminal vesicles suspected of harboring tuberculous processes should be avoided. Injury to a tuberculous prostate may result in rupture and periprostatic infection. Overdistention of the friable tuberculous bladder may cause perforation. Mechanical injury to the

tortuous, partially obstructed, ureter may induce complete obstruction necessitating emergency drainage or nephrectomy. Curettage of tuberculous foci is thought to be a factor in the development of distant metastases of disease.

SECONDARY INFECTION

The introduction of secondary infection into a tuberculous focus is usually followed by a change in the character and amount of secretion produced by the local lesion. Not infrequently an indolent infected area producing a few symptoms is converted into a more or less active one which may produce more symptoms and general sepsis. Every effort should be made, therefore, to avoid introduction of secondary organisms into a tuberculous focus, whether it be in the lower urinary tract, the kidney, or into sinuses from an infected nephrectomy wound. Should secondary infection occur, adequate drainage must be established at once and all possible steps taken to counteract the secondary invader. The use of proper aseptic technic should prevent the introduction of secondary organisms into a tuberculous lesion or wound.

CONCLUSIONS

Certain factors are recognized which, when properly utilized, may favorably influence the progress of various tuberculous lesions in the genito-urinary system. These methods are not to be used to the exclusion of surgical treatment where operative interference is indicated and other conditions are favorable for its use. Certain of these methods, particularly constitutional treatment, the use of heliotherapy and adequate treatment of other tuberculous foci, if properly used, may add materially to the chances of recovery, the comfort during life, and the prolongation of life of the patient suffering from tuberculosis of the genito-urinary tract. A broadening of the urologist's horizon, which will permit him to complement or supplement his surgical treatment of genito-urinary tuberculosis by some of these other methods, will prove of benefit to his patients and augment his reputation in the handling of individuals suffering from this disease.

HOW PREVALENT ARE SMEGMA BACILLI?

THEIR ALLEGED IMPORTANCE AS A CONFUSING FACTOR IN THE EXAMINATION OF URINE FOR TUBERCLE BACILLI BY THE SMEAR AND CENTRIFUGAL METHOD

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In the year 1905, there appeared in the *American Journal of the Medical Sciences* an article by Young and Churchman entitled, "The Possibility of Avoiding Confusion by the Smegma Bacillus in the Diagnosis of Urinary and Genital Tuberculosis—An Experimental Study." Despite their convincing work and one of their most important conclusions that "the smegma bacillus is a scant invader of the male urethra and seldom occurs in great quantity," one still sees all too often the medical man who is willing to question, quite seriously, the character of perfectly typical tubercle bacilli found by the centrifugal and smear method in the urine of patients who are obviously suffering from urinary tuberculosis. Within the past year and a half, one of us was examining a patient on one of the largest tuberculosis services in New York City. A house doctor on the service stood by, an interested observer. The patient was known to have pulmonary tuberculosis, and tuberculosis of the urinary tract was suspected. The symptoms of vesical tuberculosis were typical. Intravenous urograms and a search for tubercle bacilli in the urine were advised. A day or two later, when the findings were completed, a consultation with the same interne took place. The urograms indicated renal tuberculosis on one side at least. Numerous acid-fast bacilli, together with much pus, had been found in the urine by a competent laboratory man. Still the interne was not convinced, as was plainly evident by his question, "But how do we know these acid-fast bacilli are not smegma bacilli?" It is on account of those who are still under the spell of the smegma bugaboo that this, the work set forth in the following, was undertaken:

*The practical part of this work was carried on and completed in the Cornell Clinic just prior to the consolidation of the two institutions.

In this study, following the practice of previous observers, we have included under the designation "smegma bacilli" all bacilli staining red by the Ziehl-Nielsen method, which were found by smear or culture in material taken from those portions of the body commonly accepted as habitats of the so-called smegma bacillus. No special method, cultural or otherwise, was employed to identify the "red staining" bacilli as true smegma bacilli, but in cases where there was the slightest doubt as to possible confusion with tubercle bacilli, the smears in which the acid-fast bacilli were found were submitted to further decolorizing by allowing them to remain for twelve hours in 95 per cent alcohol. While this latter procedure is not an infallible method for differentiating tubercle bacilli from smegma bacilli, adequately stained tubercle bacilli will not be decolorized thereby. Furthermore, any patient with clinical signs of tuberculosis was excluded.

The patients employed in this study were from the following sources:

Group 1—Cornell Clinic, Urological Department, 156 males.
Group 2—Bellevue Urological Service, 118 male ward patients.
Group 3—Cornell Clinic, Gynecological Department, 174 females.

Nearly all the patients comprising Group 1 suffered from urethritis, either specific or non-specific, but chiefly chronic. Group 2 was made up of the ordinary run of ward cases such as are seen on a urologic service, exclusive of tuberculosis, i.e., cases of prostatism, epididymitis, prostatic abscess, calculous disease, et cetera. Group 3 was comprised largely of cases of urethritis and vaginitis, chiefly chronic, cases of uterine displacement and the ordinary run of gynecologic out-patient department patients.

The patients were not selected but were taken as they came. In none of the three groups were there any patients who had clinical signs of tuberculosis.

On each male patient, the following procedure was carried out. A sterile swab was introduced as far as possible into the meatus, twisted, withdrawn and a smear made on a slide. A second sterile swab was introduced into the meatus, twisted, withdrawn and a culture slant streaked. The slant was then immediately placed in an incubator. Next, the area just behind the corona glandis

(the coronal sulcus) was wiped off with another sterile swab and with this a smear was made on a microscopic slide. With still another sterile swab the same area was wiped off again and a culture tube streaked and placed in the incubator. The patient then urinated and, as soon thereafter as possible, the urine was centrifugalized at rapid speed for at least twenty mintes. From a portion of the sediment thus obtained a fairly thick smear was made on a slide, and from another portion a culture tube was streaked and placed immediately in the incubator. In order to save time, the direct meatal smear and coronal smear from the same patient were placed on the same microscopic slide, one end of which was ground sufficiently to admit the patient's name, written in lead pencil. The smears were placed far enough apart to prevent confusion. In the same manner, suspected growths from the meatal and coronal slants were examined.

In the case of the women patients, smears and cultures were made by the swab method from the meatus, the perimeatal area (the area within the labia minora) and the urine.

All of the smears, whether direct or from culture, were stained by the Ziehl-Nielsen method and in the urinary sediment smears, acid-fast bacilli were as meticulously sought for as they are in a careful search for tubercle bacilli by the centrifugal and smear method.[1]

The culture medium employed in the slants was Long's medium† which at the time was thought to be one of the best media for growing acid-fast bacilli in general. Since that time, however, Petroff's medium, which contains eggs and meat infusion broth, has become one of the most popular media for growing acid-fast bacilli, notably tubercle bacilli.

On account of the fact that we obtained only three positive cultures in all, we decided not to stress in this article the results of our cultures, believing that had we employed another type of medium, as for example Petroff's, our positive cultures might have been greater in number.

Since the presentation of the foregoing data, we have conducted a simple experiment in order to get some definite idea as to the relative merits of Long's and Petroff's media as media suitable for

†An agar medium containing asparagin, ammonium citrate, potassium phosphate, magnesium sulphate, ferrous ammonium citrate, sodium carbonate, sodium chloride, glycerine and distilled water.

growing acid-fast bacilli. This experiment was conducted as follows:

Each of ten slants of Long's medium and ten slants of Petroff's medium was streaked with a loopful of emulsion of smegma bacilli. As far as possible, the same amount of surface of each slant was covered by the platinum loop. The slants were then incubated. At the end of twenty-four hours, the cultures were examined. There was approximately a uniform growth of smegma bacilli on all of the ten Long's slants and likewise a uniform growth on all of the Petroff's slants. However, on the Long's slants the growth was definitely more profuse than that on the Petroff's slants. At the end of forty-eight hours the difference in the growth of the two media was even more pronounced, the Long's slants showing almost twice as much growth as any one of the Petroff's slants. It seems reasonable therefore to infer that the lack of more positive cultures in our clinic work was not due to the inefficacy of the medium. Of interest is the fact that the three positive cultures which we did obtain were the results of smears from women patients. In two of these patients the direct smears, made from the urethral meatus, showed numerous non-tuberculous acid-fast bacilli. The cultures made from the urines of both of these patients were positive. In the third patient from whom a positive culture was obtained, the direct smear was made from the peri-meatal area and showed numerous non-tuberculous acid fast bacilli.

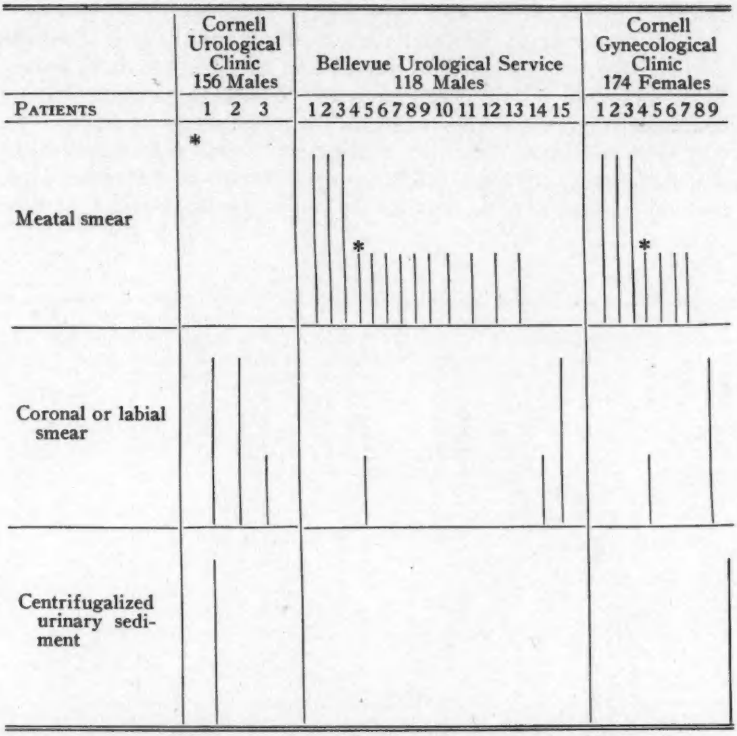
The failure to grow smegma bacilli in those instances where a few bacilli only were obtained on direct smear may be explained on the ground that too few living organisms were present to make a successful culture possible.

From the foregoing data, the following observations are of especial interest (See Charts I and II):

1. The highest percentage of acid-fast bacilli found occurred in the Bellevue patients. It seems hardly necessary to add that the average Bellevue patient may have heard the adage that cleanliness is next to godliness, but if so, he does not see fit to practice it.

2. In the Cornell Clinic groups, of which the white collar type of patient is a fair representative, there were more than twice as many positive findings in women as in men. Here, again, un-

CHART I.


Cornell Urological Clinic 156 Males
Bellevue Urological Service 118 Males
Cornell Gynecological Clinic 174 Females
Patients
1 2 3
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1 2 3 4 5 6 7 8 9
Meatal smear
Coronal or labial smear
Centrifugalized urinary sediment

Short vertical lines indicate a few scattered acid-fast bacilli (non-tuberculous).
Long vertical lines indicate a moderate to large number of acid-fast bacilli (nontuberculous).
Asterisk (*) indicates patient with positive smears from more than one source.

cleanliness is probably the answer, due, however, to anatomic rather than social differences.

3. Smegma bacilli are not as prevalent as is commonly supposed. Note the total per cent of all smears, 6.7—including three patients who had positive smears from more than one source. Only 2.7 per cent showed an appreciable number of bacilli while the remaining 4 per cent constituted smears in which only a very few scattered bacilli could be found.

4. While we found in the urethra of both sexes, combined, posi-

tive smears in twenty of the 448 patients (4.5 per cent) *positive smears from the urine were less than 0.5 per cent.*

With reference to the chief part of this study, namely, the possibility of confusing smegma bacilli and tubercle bacilli in examining the urine for the latter, it seems reasonable to state that by employing even the slightest care in the collection of the urine, the confusion need not exist. According to Young and Churchman,[2] the doubt as to the presence of smegma bacilli in the urine from the male patient may be removed by irrigating the anterior urethra

CHART II.

	Number of Patients	Positive Smears Total Number	Positive Smears (Few Scattered Bacilli)	Positive Smears (Moderate Number to Many Bacilli)	Positive Smears (Different Sources in Same Patient)
Males (Cornell Urological Clinic)	156	4	1	3	1
Males (Bellevue)	118	16	12	4	1
Females (Cornell Gynecological Clinic)	174	10	5	5	1
Total	448	30	18	12	3
Percentage		6.7	4	2.7	0.7

Positive urinary sediment smears: 2 in 448 or 0.4 per cent.

with a special form of nozzle capable of being introduced as far as the compressor urethræ muscle. Furthermore, they state that in instances where acid-fast bacilli are found in great number in the third glass of voided urine, they are in all probability tubercle bacilli, for the smegma organism is rarely found in the third glass, and then, as a rule, in small numbers only.

Bearing in mind these observations and the results of our own study, we believe that by employing the following measures in obtaining the specimen of urine from both men and women patients, the possibility of confusion by the smegma bacillus would be reduced to a minimum, if not wholly avoided:

1. Wash the genitalia thoroughly with soap and water.
2. Swab out the urinary meatus with a wet sterile swab.
3. Have the patient urinate in *three* glasses. The third glass of urine should be used for the examination.

If, in a specimen of urine so collected, acid-fast bacilli in appreciable number and resembling tubercle bacilli in morphology are found, it would seem safer to assume that such bacilli are tubercle bacilli rather than waste time haggling over the possibility that they may be smegma bacilli.

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THE RÔLE OF GLANDS OF THE FEMALE URETHRA IN THE PRODUCTION OF INFECTION OF THE URINARY TRACT.

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Of late years there has been a great increase of interest in the lesions of the female urethra. This was overdue and the female urethra has undoubtedly been a neglected field. On account of the common absence of abnormality of the urine it did not attract the attention of the general practitioner. The gynecologist often was unfamiliar with the newer methods of examining the urethra and the urologists saw these patients less frequently than would have been desirable.

The lesions of chronic urethritis and various papillary and cystic growths in the proximal portion of the urethra have now begun to receive satisfactory attention. But there is an aspect of this situation which still occupies an unsettled position, namely, the relation of such lesions and other lesions of the female urethra to the problem of ascending infection. The advent of more effective methods of treating infections of the urinary tract has required us to have much more accurate knowledge in regard to their origin, and particularly in regard to areas of chronic concealed infection which may perpetuate the process. Thus, we have come to a sounder recognition of the rôle of chronic nongonococcus prostatitis as a factor in resistant or relapsing infection in the male. This has given rise to the question of whether there are somewhat similar conditions in the female which may play a similar rôle. Thus various writers have suggested that there were about the female urethra glandular structures more or less homologous to the prostate which might be expected to act in a similar fashion. In order to assess such a possibility a pretty accurate knowledge of the presence and distribution of glandular structures seems essential. On these points the literature is quite extraordinarily contradictory. Without attempting exhaustively to survey the literature certain evidences of lack of agreement may be submitted.

Jordan and Kindred say "rudimentary tubules occur in a com-

parable position [to the prostate] in the female and are known as the para-urethral ducts [of Skene]. No connective tissue nor smooth muscle develops around these tubules."

Arey says that these isolated para-urethral ducts of Skene number, at most, three.

Johnson, as a result of his embryologic studies, concludes that "the true urethra, i.e., that portion corresponding to the whole female urethra, terminates at the point where the utero-vaginal canal joins the [urogenital] sinus." Therefore, the male and female urethra can be compared only above the level of the sinus pocularis. In the prostatic urethra, Johnson did not find any glands except the prostatic glands. Thus, any glands that might be found in the female urethra would be, by presumption, homologous to prostatic glands. It appears to be generally accepted that Skene's glands are similar in origin to prostatic glands arising below the level of the utricle.

Eggerth has shown the bulbo-urethral glands, or glands of Cowper, to be homologous to the glands of Bartholin.

Piersol describes the female urethra as containing "small tubular alveoli that open by minute ducts on the mucous surface and correspond to Littré's glands in the male. They are most plentiful in the upper part of the urethra and in aged subjects may contain concretions. The mucosa is also pitted with small crypts similar to those in the male into which the ducts of glands often open."

Maximow describes numerous smaller and larger invaginations formed by the epithelium. The out-pocketings in their walls are lined in many places with characteristic mucous cells—as in the glands of Littré in the male. These may accumulate colloid material in their cavities or may even contain concretions.

Hinman says that submucosal glands (Littré's) are not duplicated in the female urethra. Their homologues are poorly developed structures known as the minor vestibular glands.

Folsom describes a definite group of tubular glands located around and opening into the posterior portion of the female urethra, and which show all the various changes which have been found in the prostatic ducts and tubules of the male. They are frequently widely dilated by retained secretion into large cystic areas which occasionally have gone on to calcification. In some cases he has

demonstrated the presence of gland-like structures at the base of the polypoid or papillary masses found at the bladder neck.

Renner, examining a group of eight specimens found at postmortem in women past middle life, draws some quite dogmatic conclusions:

"1. The female urethra shows much resemblance to the male urethra, especially in its relationship with accessory glands, genital apparatus, and Cowper's glandulæ bulbo-urethrales.

"2. The unilocular cysts and Skene's ducts are to be considered as para-urethral glands.

"3. Acinous formations are of prostatic origin, especially when they are embedded in the smooth musculature.

"4. Corresponding to the colliculus seminalis, a submucous cyst is to be found in the female urethra, surrounded by prostatic glands so that the prostatic utriculus can be seen in rudimentary form.

"5. The concretions which are eventually found in the prostatic glands correspond morphologically and in their consistency absolutely to the male prostatic concretions.

"6. The physiological and pathological anatomical findings which have been mentioned are of an importance for the application of urology, which should not be underestimated, as concretion formation in the urethral muscularis mucosæ may cause severe complications, such as ulcers, phlegmons, or strictures."

This will serve to show the diversity of opinion and make one inclined to agree with Hirsch, who remarked, in 1926: "A review of every available textbook on anatomy, histology, venerology, and urology in English, French, German, and Latin reveals such diverse descriptions of the glands and lacunæ [of the female urethra] that one wonders whether or not an anatomic structure is being dealt with."

Obviously we cannot proceed far without more evidence of the basis for such claims as that the proximal portion of the urethra in the female is commonly supplied with glands similar to and homologous with the prostate in the male.

AN ANATOMIC STUDY OF THE FEMALE URETHRA

To prevent repetition of well-accepted facts, the distal third of the urethra, which contains the ramifications of Skene's glands, will not be included in this discussion.

Material.—We had at our disposal fifty-one specimens obtained from current postmortem examinations done at The Mayo Clinic

during the first three months of 1936. In addition, we had eight specimens received through the courtesy of the Department of Pathology of the University of Minnesota, taken from their postmortem examinations of the newborn. All age groups are well represented, as shown in Table I.

Causes of Death.—With the exception of one patient, all of these specimens were obtained from patients who died of causes un-

TABLE I

Decade	Number of Cases
0	15
1	4
2	3
3	5
4	5
5	11
6	9
7	12
8	9
9	2

associated with the urinary tract. This patient died following an operation for nephrolithiasis and pyelonephritis. A woman of eighty-five complained of burning on urination and hematuria, and at necropsy carcinoma of the renal pelvis was found. These two patients were the only individuals who had any history of urinary disturbance noted.

Preparation of Material for Examination.—In preparing the material, the urethra, with the bladder, was removed intact and opened through the roof, allowing inspection of the mucosa.

Gross Pathology.—Only four specimens of the fifty-nine showed gross pathologic changes:

Delicate polypi were found at the bladder neck of a patient aged sixty-six, although without urinary symptoms.

Two specimens presented small, yellowish, opaque nodules in a longitudinal linear distribution around the bladder neck. These patients were, respectively, eighteen and forty-nine years of age and had no urinary symptoms.

Particular interest attaches to the patient previously referred to with carcinoma of the renal pelvis and who complained of bladder

disturbance. Just distal to the internal vesical sphincter were two small nodules about 2 mm. in diameter and 1 mm. in elevation. On examination, these were similar grossly and microscopically to the conditions described by Folsom and Renner.

Microscopic Examination.—In preparing this material for microscopic study, blocks were cut longitudinally in the midline from the floor of the urethra and multiple sections were made from

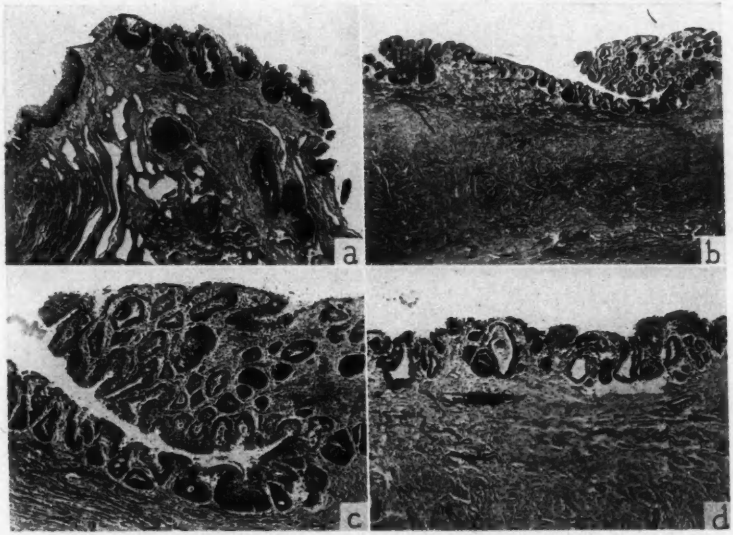

Fig. 1*a*, *b*, *c* and *d*. Deep crypts in urethral mucosa ($b \times 13$, $c \times 42$).

each block. In some cases, cross sections were taken in the vicinity of the bladder neck. All sections were stained with hematoxylin and eosin.

No gland-like structures were found in the urethrovaginal septum of the proximal two-thirds of any of these sections. In thirty-two of the fifty-nine cases there were groups of epithelial cells in the submucosa. There were solid buds of epithelium and there was a gland-like arrangement. Closer examination by means of serial or semi-serial sections proved that there were two mechanisms involved in the production of this appearance. Many of these gland-like

structures could be traced to their junction with the urethral mucosa and by reconstruction of the specimen it was found that they were deep crypts in the mucosa formed by the numerous folds in the undistended urethra. Figure 1 illustrates these crypts. It was quite evident that the epithelium lining these gland-like structures was exactly similar in arrangement and staining properties to the urethral epithelium. In two specimens there were small groups of

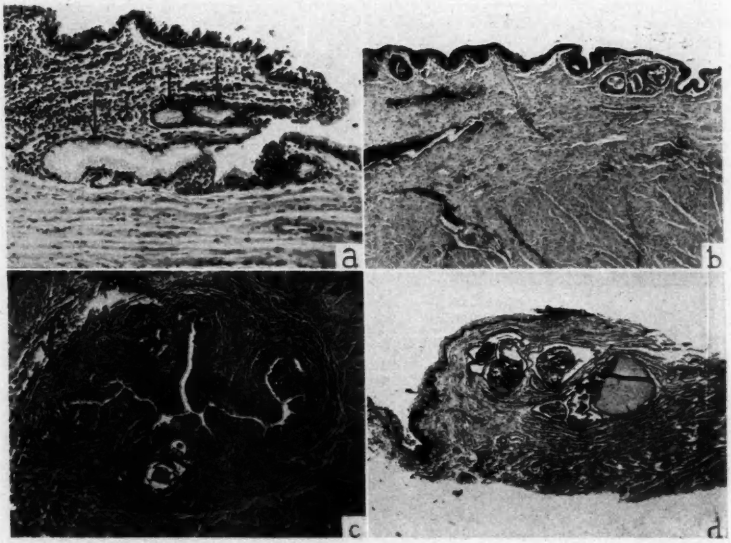

Fig. 2*a*. Small groups of epithelial cells with foamy, palely-staining cytoplasm replacing ordinary transitional epithelium; *b* and *c*, cysts, and *d*, tissue from patient with carcinoma of renal pelvis.

epithelial cells with foamy, palely-staining cytoplasm which replaced the ordinary transitional epithelium. These cells were not in a gland-like arrangement as can be seen in Figure 2*a*. When specific stains were used they were found to contain mucin. We think they represent areas of secretory epithelium rather than true glands.

Cysts.—The isolated cell nests and small cysts commonly containing an albuminous substance, when traced through serial sections, often have no connection with the urethral mucosa. Figures

2b, c and *d* illustrate the various cysts of all sizes found in different specimens. Figure *2d* represents the findings in the patient with carcinoma of the renal pelvis previously referred to who showed small nodules just below the vesical neck. The close resemblance to the condition described by Folsom (reproduced in Figure *3a*) should be noted. These cysts appear to be the result of some chronic irritation causing the epithelium to proliferate

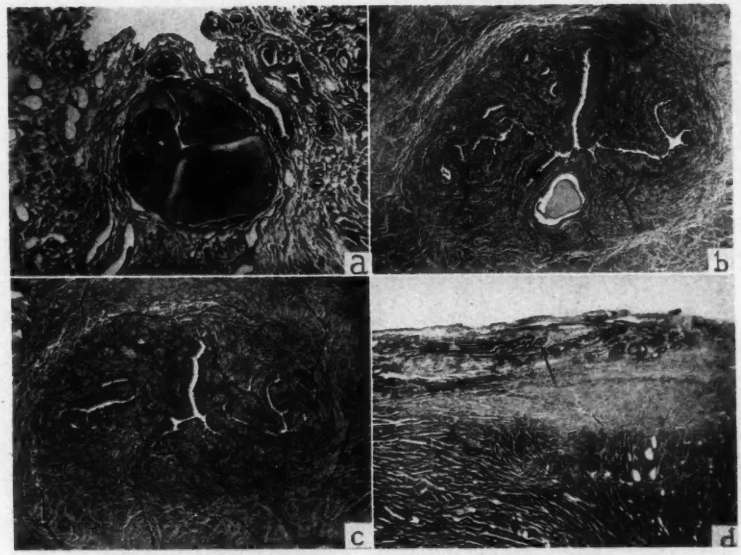

Fig. *3a*. Cysts (after Folsom); *b* and *c*, two sections (200 microns apart) of urethra of an infant with hydrocephalus, and *d*, small bit of colloid material lodged in folds of mucous membrane.

downward, and in time it becomes pinched off from the mucosa proper. At a later stage a process of central necrosis and liquefaction takes place and a small cyst is formed. The question may be raised as to how these cysts develop if there is no secretory mechanism concerned. This may be explained by continued growth of the peripheral epithelium and simultaneous necrosis of the central cells. Stains for mucin (Galantha mucin) showed no mucus, either in the lining cells or in the cyst fluid. Interestingly enough a similar situation was found in an infant stillborn at term with

hydrocephalus (Figs. 2*c*, 3*b* and 3*c*). Obviously there has been here no opportunity for infection which might close the mouth of a gland, causing retention of secretion. The explanation must be sought elsewhere. Careful examination of sections showed no connecting duct or stalk between the cyst and the lumen of the urethra. This specimen also nicely illustrates how what appears to be a gland in one section turns out to be merely the cut off top of a deep fold of mucosa.

So-called Corpora Amylacea.—We next turn to the question of the alleged formation of corpora amylacea in these cysts and the conclusion of Renner apparently based upon this finding to the effect that these glands are homologous to the prostate. The albuminous fluid of these cysts may become solidified and shaped by the cavity in which it is contained so as to produce a superficial resemblance to the corpora amylacea of the prostate. It should be noted here that the finding of corpora amylacea in gland-like structures does not warrant the suggestion that their finding suggests prostatic glands. Corpora amylacea may occur almost anywhere, being found in the lung, spinal fluid, and so forth, where colloid may collect and solidify. Figure 3*d* shows a small bit of colloid material which has become imperfectly calcified and is lodged in one of the folds of the mucous membrane. That these large cysts are the end-stage of solid buds of epithelium is strongly suggested by Figure 4*a*. There are here both cell nests and small cysts in the mucous membrane, and the mucosa at this point, although it is nearer the internal sphincter than the large cysts, is stratified squamous epithelium. As far as we are aware, nobody suggests that squamous epithelium has secretory activities. If these were true glands, one would expect them to be present from fetal life onward rather than to be developments of later life as they obviously are. We should expect them to continue to produce secretion and to discharge it rather than retain it. We find no evidence of infection around these large cysts which might be held to account for obstruction of the duct. In fact, by serial sections it is impossible to demonstrate a duct or any similar structure. If these were true glands, it should be possible to demonstrate specific secretion such as occurs in the prostate. No corpora amylacea were found in any of the specimens studied. These colloid-containing cysts in the urethral mucosa and submucosa appear to us

to be formed from von Brunn's cell nests. This is the same mechanism which produces the colloid-containing cysts found elsewhere in the urinary tract and commonly referred to as "cystitis" or "urethritis cystica."

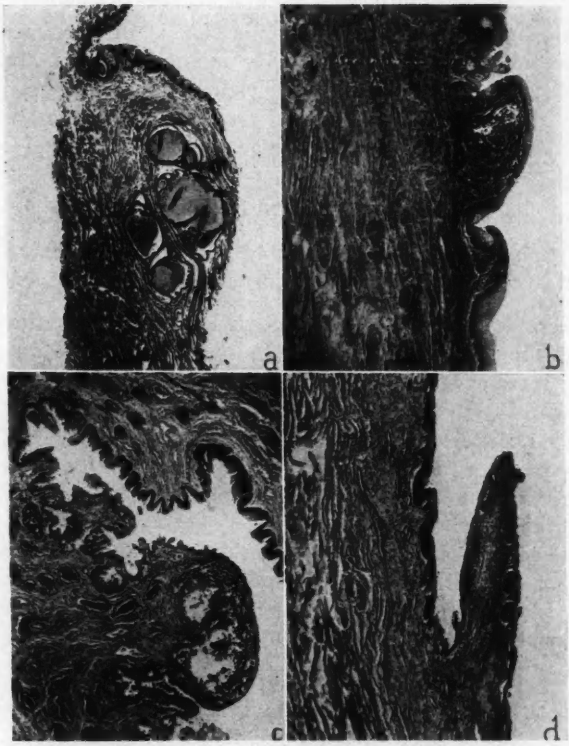

Fig. 4*a*. Cell nests and small cysts in mucous membrane, *b* and *c* (cross section) collections of lymphoid cells with no evidence of glandular elements, and *d*, section of polyp from bladder neck.

Nodules and Polypi at Bladder Neck.—In the other two cases, with nodules at the vesical neck, these proved to be collections of lymphoid cells with no evidence of glandular elements (Figs. 4*b* and 4*c*). The bladder-neck polyps previously referred to showed,

on section, a connective tissue stalk covered by epithelium which contained a few solid cell nests (Fig. 4*d*). It is of interest to note that the patient with upper urinary tract infection and nephrolithiasis showed no evidence of glands or even deep crypts in the urethral mucous membrane.

Findings in Infants.—In the examination of the specimens from premature infants, ranging from six months to term, there was no evidence of any glandular or cystic formation except in the one case already discussed. Serial cross sections were studied in two of these cases and nothing suggesting a gland could be demonstrated.

COMMENT

This study of material reasonably varied and of fair amount seems to us to warrant the following deductions:

1. There is no evidence of true glands in the proximal two-thirds of the female urethra. Two specimens were found with areas of secretory epithelium in the mucous membrane and not extending into the submucosa.
2. The structures referred to as "corpora amylacea" by Renner are not specific products of the prostate. To refer to them as evidence of gland structures homologous to the prostate simply confuses the issue.
3. The colloid-containing cysts in the urethral mucosa and submucosa are formed from von Brunn's cell nests. The mechanism of their formation is the same as that of the colloid-containing cysts elsewhere in the urinary tract. They may properly be designated as urethritis cystica.

Returning now to the question suggested by the title of this paper, namely, the relation of the gland structures to infection of the urinary tract in the female, we feel required to disagree with the position taken by Renner, Folsom, and others. Their view that glandular structures are the basis of infection does not seem to us tenable. Their position is further weakened by the well-known behavior of the urethra when infected by the gonococcus. This type of infection commonly runs a mild course and goes on to recovery except when it is complicated by involvement of Skene's glands or those of Bartholin. These glands are generally accepted

as homologous respectively to the prostatic glands and the glands of Cowper. But Skene's glands lie in the distal third of the urethra and are out of the field of the present discussion. The glands of Bartholin obviously do not enter at all. Now if there were important gland masses in the proximal two-thirds of the urethra, they would certainly become involved and prolong the inflammatory process. Experience suggests that this does not occur.

Looked at from another point of view, inflammation of the urinary tract of the so-called ascending type is notoriously common in female children. These infections are assumed to reach the bladder through the urethra and might properly be expected to invade gland masses in the proximal urethra if such existed. As far as we know, chronic posterior urethritis in children is not believed to be a common lesion. Finally, it is notorious that the lesions of the female urethra to which reference was made at the beginning of this paper are characterized by normal or substantially normal urine. This speaks against a glandular origin—not for it.

CONCLUSIONS

1. The histologic evidence seems to indicate that there are no important gland structures in the proximal two-thirds of the female urethra.
2. The clinical evidence does not suggest the presence of such glands.
3. Glands of the female urethra—except Skene's glands—do not play an important rôle in infection of the urinary tract.

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TRAUMATIC RUPTURE OF THE PENILE URETHRA

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Uncomplicated rupture of the penile portion of the urethra, especially that due to transmitted force, is an exceedingly rare injury. In the case to be described, lacerations of the urethra at the penoscrotal level, occurred during coitus as the result of impact of his

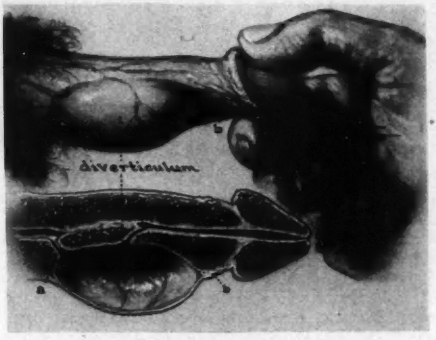

Fig. 1. Appearance of the penis with the diverticulum distended with urine. (Inset) Schematic drawing of condition as demonstrated in the urethrogram (Fig. 2) and at operation.

consort's body against the erect organ of the victim. It is noteworthy that the corpora cavernosa escaped demonstrable injury.

CASE REPORT

J. R., aged thirty, was admitted to the Pennsylvania Hospital on April 16, 1935, complaining of great urinary difficulty and the presence, during voiding, of a localized swelling on the penis. The trouble began one year before with the receipt of the injury described above, which was followed by pain, urethral hemorrhage, marked swelling of the penis and scrotum, and retention of urine. The superficial tissues were intact. A soft rubber catheter was introduced by the family physician and retained for two weeks. During this interval an abscess formed, dissected forward, and opened spontaneously in the coronal

sulcus. Upon removal of the catheter, it was found that the abscess cavity transmitted urine. The urinary fistula persisted for ten weeks and then closed spontaneously. Thereafter a swelling appeared on the penis during voiding (Fig. 1). This was fusiform and extended from the site of the urethral injury onto the right side of the penis to the level of the coronal sulcus at the site of the healed fistula. Its greatest width when distended was approximately 1.5 cm.

There was marked urinary difficulty, frequency, urgency and pyuria. Of the many attempts made to pass instruments, three were said to

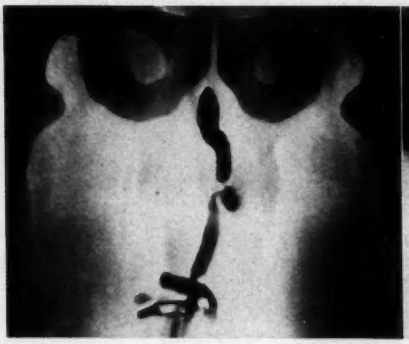

Fig. 2 *(left)*. Urethrogram showing pseudo-diverticulum of urethra. This was made one year after traumatic rupture of the canal occurred. Note the narrow channels between the sac and the intact portions of the urethra.

Fig. 3 *(right)*. Urethrogram made six months after operation. Note the slight constriction at the point of anastomosis.

have been successful and on these occasions bougies with guides were introduced.

Examination.—Aside from mild renal dysfunction and hypertension 165/80, general physical examination was negative. A small depressed scar was visible in the coronal sulcus and extending from this to the urethra at the peno-scrotal junction a fibrous cord could be felt together with a localized thickening of the urethra where the cord joined it. These defects produced no visible deformity but on attempting to void the swelling already described appeared and subsequently disappeared with completion of micturition, the latter being accomplished by prolonged dribbling. Explanation of this is found in the urethrogram (Fig. 2) and in the diagrammatic drawing (Fig. 1) which showed a pseudo-diverticulum communicating with the intact portions of the urethra by means of strictured segments of the canal.

Operation.—Operation was performed April 23, 1935, using spinal analgesia (neocain, 100 mg.). A rectangular flap including the diver-

ticulum was turned ventralward from the side of the penis. The diverticulum was then separated from the flap and removed together with segments from either end of the torn urethra. Slight mobilization of the urethral segments permitted their approximation and anastomosis was made with fine chromic catgut sutures over a soft rubber catheter. The operative area was covered with a flap of Bucks fascia and rubber tissue drains inserted.

Postoperative Course.—The catheter was removed on the twenty-third postoperative day. With the exception of slight infection and urinary leakage the convalescence was uncomplicated. On June 5, 1935, the fistula was closed and voiding was normal. The canal admitted a No. 24 F. sound without evidence of stricture. The patient is now perfectly normal, there is no incurvation of the organ when erect and little or no tendency to contraction at the site of operation. A urethrogram (Fig. 3) made six months after operation discloses slight constriction at the site of anastomosis.

DISCUSSION

DR. EDWARD L. KEYES (New York, N. Y.): I believe with Dr. Herman that we are entirely too conservative, not only about resection of the strictured urethra, but in particular about re-operative resection of the strictured urethra. Operating, as Dr. Barringer would, conservatively, gently, not tearing things all to pieces, but doing each operation with the idea of doing something, but as little as possible, we tell the man quite frankly, "You may be back here on the operating table in six months or a year, but if we can combat it in the end, we shall reduce rather than increase the amount of your scar and you will be cured."

The tradition that anterior strictures will remain cured if dilated for a few months and that bulbar strictures, bulbomembranous strictures will not be cured holds good for the usual treatment, but resection, I think, can cure them all.

DR. HUGH CABOT (Rochester, Minn.): The chief conclusion that we are inclined to draw is that there are no glandular structures of importance in the proximal two-thirds of the female urethra. Therefore, to use this as a stalking horse to explain infections of the upper urinary tract is simply misleading. Particularly I want to point to the erroneous analogy between the contents of the cysts and the so-called corpora amylacea. They are not analogous and are simply cystic degeneration.

Finally, I think it has been shown by Dr. MacKenzie's paper and by this paper, as well as by previous papers, that urethritis cystica is an important lesion. Of course, we have all known of it, but I think we have lacked quite as much confirmation as we have now.

DR. LEON HERMAN (Philadelphia, Pa.): I regret that Dr. Cabot's paper has not elicited more discussion inasmuch as the pathogenesis of these cysts as well as their clinical importance seems to be little understood. I would like to ask Dr. Cabot and Dr. McKenzie if the cysts to which they refer are similar to those reported some years ago by Dr. Pelouze of Philadelphia, who thought they were symptomatic of tuberculosis. These cysts, if multiple, may cause acute retention of urine, especially in women. We have had

several cases of this kind which have been treated by transurethral resection with good results.

DR. CABOT: The cysts are exactly the same as those described by Pelouze.

DR. HERMAN: Polypi at the outlet of the female bladder are of considerable clinical importance. By strange coincidence in the last few weeks we have had three insane women referred for treatment, all of whom were supposed to have toxic psychoses. In one of these patients we found duplication of the ureter on the left side with a large ureterocele. This patient was carrying 20 ounces of pussy residual urine. An electro-incision of the ureterocele removed her bladder difficulty, which was due to obstruction of the vesical outlet by the large ureterocele. Another patient had marked urinary difficulty and was thought to have a papilloma of the bladder. I was asked to pass judgment upon the nature of the tiny bladder excrescence which biopsy report classified as papilloma. This was an insignificant inflammatory excrescence, but I found at the posterior arc of the bladder outlet a long pedunculated polyp the removal of which relieved the patient entirely of her urinary obstruction.

I am very much obliged to Dr. Keyes for his discussion.

PYOPAGUS TWINS

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In the literature of abnormal teratological development, the occurrence of pyopagus twins is rare. Twenty-three instances have been collected by Perlstein and LeCount, to which this present pair can be added, since it was not included in their list.

The present instance, Mary (the right twin) and Margaret (the left one) came under observation because of an attack of abdominal pain experienced by Margaret which had been suspected as due to renal calculus. When seen in 1933 the twins were twenty years old.

The father and mother are both well; he is forty-eight years old and she is forty-three. There is one sister, who is living at the age of ten years. There have been no miscarriages, stillbirths or deaths in the family. In neither the father's nor mother's family has there been any instance of multiple births. There is no history of tuberculosis, syphilis or insanity in either parent or family.

The twins were born conjoined in the sacral region, at the end of the seventh month of pregnancy. Their combined weight was 7 pounds. At one and one-half years they each could talk, and at about three years they had learned to walk. Both girls have had whooping cough, measles, scarlet fever and chicken pox. On each occasion it appears that Margaret took the disease first, and was followed in a day or two by her sister Mary. Their symptoms were about the same. Once, about six years ago, Mary had bronchitis, but Margaret developed no respiratory symptoms.

Catamenia appeared in each girl at the age of thirteen years and they have been regular and simultaneous since. Though they have a common anus so that the single defecation serves for both, their bladders are not united and either one is able to urinate independently, though usually this act is also performed in unison.

Both girls were educated by private tutors up to about the ninth grade. They appear to be of average intelligence and have traveled considerably. They appear in no way self conscious, for naturally they long ago became used to being objects to be stared at by the curious. In walking Mary usually walks first, while Margaret walks backward in step with her. They have learned to dance after a fashion, and to use roller-skates. Also they have learned to play the piano. They have different likes; Margaret likes reading, Mary sewing. Neither girl appears to dominate the other.

Present Illness.—About six months ago Margaret had dull pain in

the right side of the abdomen which tended to radiate posteriorly toward the kidney on that side. At intervals this pain was sharp but not so severe as to require morphine. At first she was slightly nauseated, but since limitation of her diet she has no longer been so. There have been no symptoms referable to the bladder. A small amount of pus has been found by the attending physician in the urine spontaneously passed, but no catheterized specimen has been examined. Films taken five months ago and an intravenous urogram two months ago seemed to show evidence of a right renal calculus. Mary has had no symptoms.

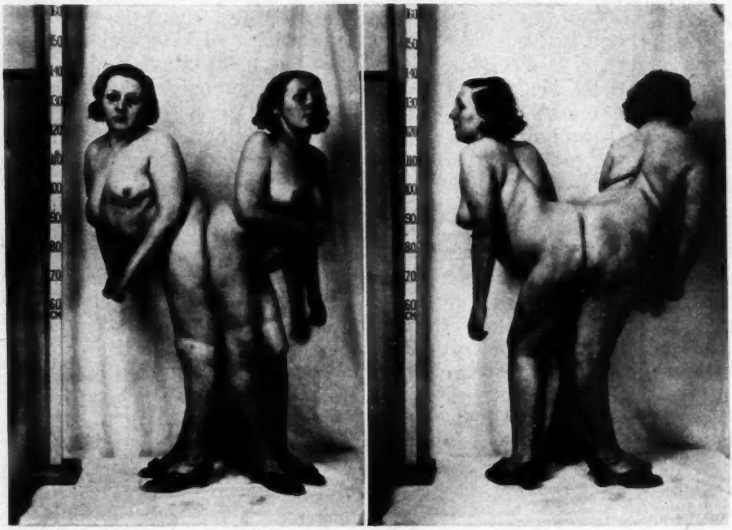

Fig. 1. Appearance of twins at age of twenty years.

Physical Examination.—The girls were both well nourished and appeared to be in good health. Their combined weight was 245 pounds. Their bodies are joined posteriorly by bony fusion of the sacrum at about its middle. In order to face in the same direction the girls have grown accustomed to rotate the spine, Margaret to the right, Mary to the left. This has caused a marked scoliosis in the spine of each. They are unable to rotate their bodies beyond the transverse axis in the other direction.

In general facial appearance, the twins resemble each other no more than is usual in single children of the same parents. They do not ap-

pear in the least like identical twins. Mary is the heavier of the two and has a slight ptosis for which she wears glasses.

The skin, head, ears, nose, mouth and neck of each girl is normal. The thorax of each is deformed by the marked scoliosis. Examination showed limited expansion in the left lung of Mary, and the right of Margaret. No abnormal breath sounds could be heard. The breasts were normal. Examination of the heart of Margaret showed it to be in normal position. There was a systolic murmur present, most marked at the apex. There was evidence also of sinus arrhythmia. The pulse was 95 per minute. The heart of Mary is definitely pushed toward the right, so that the apex beat was felt to the right of the sternum. Sounds were regular without murmurs, but here also there was evidence of sinus arrhythmia. The pulse rate was 85 per minute. The blood pressure of Margaret was 150/90 in each arm. That of Mary was 148/96 in the left arm; 150/94 in the right arm. Examination of the abdomen of each girl showed it to be normal. There was no tenderness in the case of Margaret, the one suspected to bear a calculus. The extremities of each are all normal, and there was no evidence whatever of either deformity or trophic disturbance in the feet such as might accompany a spina bifida occulta. In addition to the bony union of the sacrum, each buttock is somewhat fused.

The exterior genitalia show a common vulva with labia majora and minora directly continuous transversely from one individual to the other. Within this each girl has a separate, intact hymen and vagina, a separate urethra and a normal clitoris. Posterior to the vulva there is a common anal orifice with normal sphincter of good tone. There is no dimpling of the skin or other suggestion of another imperforate anus. A normal uterus in each girl can be felt on rectal palpation.

An opaque enema was given and x-ray showed a complete separation of the rectal ampullæ just above the anus. The opposing surfaces were flattened by a septum less than 1 cm. wide. Each sigmoid was normal.

Electrocardiograms showed normal curves and no evidence of dextrocardia in either twin.

The urologic examination of Margaret consisted of cystoscopy, on which the bladder was found to show evidence of slight cystitis. The right ureter was catheterized, the instrument passing without obstruction for the normal distance. Urine from the right kidney was normal except for an occasional leukocyte. The report of the roentgenologist was as follows: "The radiographs of the right kidney area show a catheter in the ureter reaching the kidney region. There is no evidence of calculus. There is considerable scoliosis. Pyelogram shows the renal pelvis small and smooth, apparently normal. Radiographs of the chests show marked scoliosis, especially in Margaret. The lungs are clear. Radiographs of the pelves taken laterally and by stereoscope show firm bony fusion between the sacra, with a continuous vertebral column, practically end on, bridging between the two. The

neural arches are defective at the point of fusion. The bones elsewhere are separate and distinct."

At the time of cystoscopy, Mary also felt some slight discomfort as the instrument passed through the urethra of Margaret. This, together with sensory tests made over the vulva and adjacent skin, indicated some overlapping of the sensory nerve supply in these regions. A hypnotic (pentobarbital) given to one girl, by mouth, had almost no effect on the sister, making it probable that there exists only a

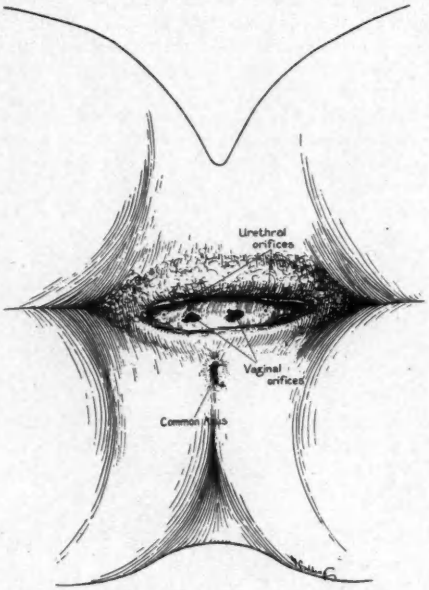

Fig. 2. Drawing of conjoined area showing a common anus but separate urethral and vaginal orifices.

slight direct vascular communication between the twins. This is in agreement with the observation of Plaggemeyer on the Samar twins (boys) after the administration of methylene blue to one of the pair. That there is sufficient vascular intercommunication, however, for endocrine and hormonal effects is shown by the simultaneous menstruation of the girls. In the case of the "Bohemian Twins" reported by Perlstein and LeCount, following pregnancy and delivery of one of the girls, there was milk in the breasts of both.

It is beyond the scope of this present communication to discuss all the theories concerning the occurrence of conjoined twins. The condition doubtless represents an arrested state of development of normal twins early in the blastomere stage of the embryo. The reader is referred for further detail to the excellent article of Wilder in which he correlates all the varieties of double monsters of which this is but one.

A more practical question concerning conjoined twins is that of the possibility of their being successfully separated by surgical intervention. As a matter of fact our girls were taken to the Children's Hospital in Boston at an early age of infancy to be studied with a view to their separation. The examining surgeon at that time decided that it was not possible. Baudouin, writing in 1902, shortly after the successful separation by surgery of a pair of twins joined by the sternum (thoracopagi) has discussed this question. He states that operation may be either (a) one of election, (b) one of urgency in order to save the life of the one, the other being sick, and (c) of necessity, after one twin had died. He points out correctly that with our present more detailed methods of study, it is quite possible to get evidence in each case as to the likelihood or not of surgical success. It would seem that the possibility of successful surgical separation will rest mostly on the state of the nervous system, for the intestinal and genital fusions can be controlled. It is evident, however, that if any separation is to be undertaken it should be at an early age before such static changes as scoliosis and cardiac malposition have had opportunity to occur.

It is a sad commentary on the cupidity of human nature, however, that in several instances any suggestion regarding separation has been objected to by the parents, who have preferred to exploit the twins in circuses and concert halls. In the present instance, this was not the case, and it would seem today, from a study of these girls, that at the expense of an artificial anus in one twin, surgical separation could have succeeded in giving each an independent existence.

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THE EFFECTS OF THE ESTROGENIC HORMONE ON THE UROGENITAL TRACT OF THE MALE MACAQUE MONKEY, AND UPON GONORRHEAL URETHRITIS IN MAN

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The hormone estrin is the active principle first derived from the growing ovarian follicle. Substances which have estrogenic action have been extracted from many other body tissues and fluids, such as the placenta, amniotic fluid, and the urine of pregnancy. Wislocki[10] found that the estrin which is abundant in the maternal circulation during the latter part of pregnancy causes external changes in the newborn male monkey, such as pink erect nipples and descended testicles with swelling and reddening of the scrotal skin. Halban[5] had suggested in 1904 that sex hormones present in the pregnant woman are able to pass the placenta and affect the reproductive organs of the fetus, which changes later undergo postnatal involution. Our study is particularly concerned with the cellular response of certain parts of the urogenital tract of the male monkey to the injection of estrin.

This experimental study was reported in detail by one of us (Dr. van Wagenen[9]) in 1935. Briefly, the results obtained by injection of 9,000 international units of theelin, the estrogenic hormone, into a male macaque monkey weighing 2,450 grams were as follows:

1. Theelin caused a hyperplasia of the fibro-muscular stroma of the seminal vesicles and prostate. The seminal vesicles weighed five and one-half times those of its control.

2. Theelin also effected an epithelial hyperplasia and metaplasia in specific parts of the urogenital tract. The one or two cell, deep cuboidal epithelium of the prostatic utricle and the three or four cell epithelium of the verumontanum and the membranous and penile urethra became stratified in type and fifteen to twenty-five cells in depth. Cornification of the superficial layers gave it the appearance of vaginal epithelium.

It has long been accepted by many authorities that the gonococcus has a distinct predilection for columnar epithelium. Bumm,[3] in 1885, studying the pathologic changes of gonorrheal infections of mucous membrane, chiefly in the conjunctiva, came to the following conclusions: (1) Only columnar epithelium succumbs to the invasion of the gonococcus. (2) The gonococcus cannot enter the intact squamous epithelium. Under the influence of the gonorrheal process, there is found in the phase of repair a stratified

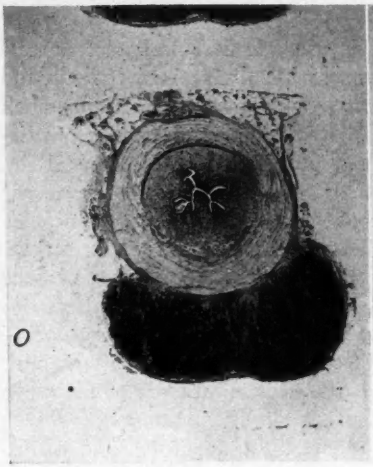

Fig. 1. Section through prostatic urethra of a normal monkey (×8).

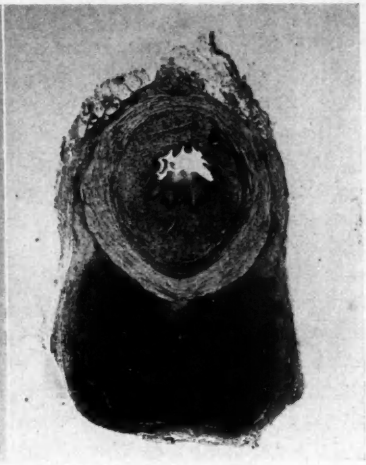

Fig. 2. Theelin-injected monkey. The mucosa of the prostatic urethra shows an epithelial proliferation on the floor (×8).

squamous epithelium instead of the normal columnar epithelium. This hinders further advance of the gonococcus.

A few years later, Finger,[4] after making careful examination of sections of the urethra thirty-six to forty hours after infection, reported a transition of columnar epithelium in the process of repair. The work of these older writers has not met with any satisfactory contradiction until very recently, to which we shall refer later.

Allen,[1] in 1928, studying the effects of theelin on the immature female monkey, noted a change in thickness in the vaginal epithe-

lium from four to eight cells to thirty cells. The therapeutic application of this biologic knowledge was realized by Lewis,[8] and in 1933 he used it successfully in the treatment of gonorrheal vaginitis in children. Since then, favorable results have been quoted by Brown,[2] Huberman and Israeloff[7] and others. This treatment is now being used extensively, and a more accurate evaluation will soon be possible.

In a very recent study, Hall and Lewis[6] believed it is unlikely

Fig. 3. Section through membranous urethra of a normal monkey (× 15).

Fig. 4. Theelin injected monkey. The epithelial proliferation of the membranous urethra still confined to the floor (× 15).

that following the administration of theelin a mere histologic change of the infected part could be solely responsible for the destruction of the invading gonococcus. In vitro, gonococcus grows best in a slightly alkaline medium with an H-ion concentration between 7.2 and 7.6. If the acidity becomes greater than pH 6 the culture will rarely survive. Following the administration of theelin in female monkeys and girls, a change was found in the ion concentration of the vaginal fluid to an acid reading of pH 5.9 to 5.0 or even a lower figure. Ordinarily, the vaginal secretion in children is neutral or faintly alkaline. With vaginitis, it is apt to show a slightly acid reaction. Hall and Lewis therefore conclude that following the use of theelin many layers of cells which appear in the vaginal mucosa contain glycogen. As these

cells break down, lactic acid is produced from the glycogen, forming an acid secretion, which destroys the gonococcus.

Our study of the effects of theelin on the urogenital tract in the male monkey suggests to us the further application of theelin therapy to gonorrheal urethritis in the human male.

To render results comparable in the small number of patients treated, only those cases with acute anterior gonorrheal urethritis previously untreated and with no history of previous infection

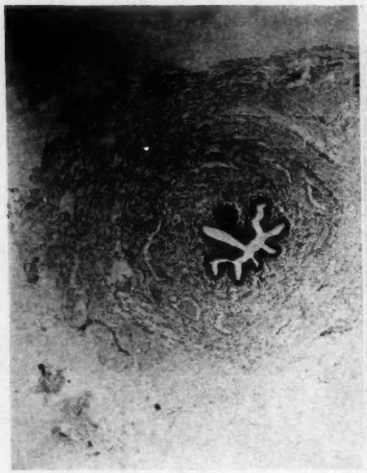

Fig. 5. Section through penile urethra of a normal monkey (×8).

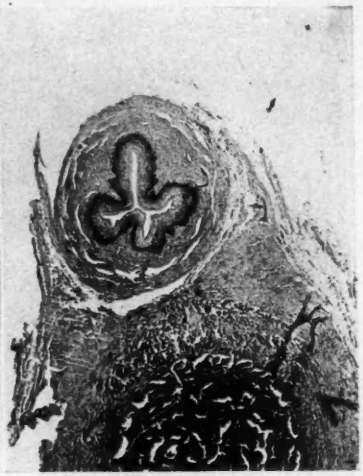

Fig. 6. Theelin-injected monkey. The epithelial proliferation of the penile urethra completely lines the lumen throughout.

of the urethra, were chosen. Diagnosis was based upon the history of exposure, the findings of Gram-negative intracellular diplococci in smears from the urethral discharge, with associated symptoms and signs of infection.

As an index of the progress of the treatment it was decided to use the ratio E/P, epithelial to pus cell ratio, as found in smears from the discharge and urinary sediment. Increase in epithelial cells would be expected with cornification of the mucosa and decrease of the pus cells with subsidence of the infection, both factors thus tending to increase the ratio with improvement of the disease.

Theelin was administered intramuscularly deep into the buttocks, daily or every other day, and treatment extended over an average period of two weeks.

The dosage was a large part of the problem. In our study of the monkey, 2,000 international units per kilo produced very pronounced results both grossly and miscroscopically. The smallest effective dose was 1,000 international units per kilo. Our largest

Fig. 7. Higher power of the penile mucosa of a normal monkey (× 165).

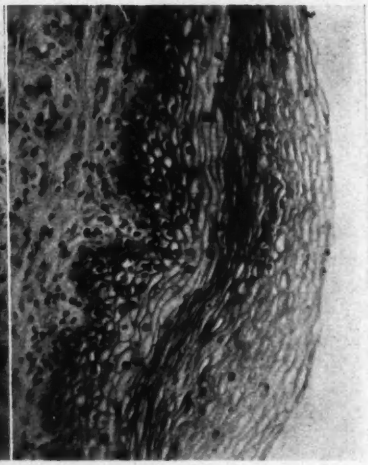

Fig. 8. Theelin-injected monkey. A higher power of the mucosa of the penile urethra, showing intra-epithelial zone of cornification (× 165).

dose given without effect was 730 international units per kilo. Therefore, considering the magnitude of the change brought about by 2,000 international units per kilo and the great unexplored range of dose down to 730 international units per kilo, it was thought best to start with quite moderate amounts in the human subject. No local irritation resulted from the administration of theelin, nor were there any unfavorable general symptoms noted.

REPORT OF CASES

1. A series of six cases with dosage of 2,000 international units given in a period of twenty days. No change in course of disease. No change in E/P ratio.

2. Series of six cases with dosage of 4,000 international units over a period of twenty days. No change in course of disease. No change in E/P ratio.

Case A.—With dosage of 48,000 units over a period of thirteen days. No change in the course of disease. No increase in the E/P ratio.

Case B.—With dosage of 84,000 international units over a period of thirteen days. Slight decrease in discharge. Variable increase in E/P ratio. Smears from discharge continued to show gonococcus two weeks subsequent to last treatment.

Case C.—Dosage of 86,000 international units over a period of sixteen days. Slight decrease in discharge. Variable increase in E/P ratio. Smears from discharge continued to show gonococcus two weeks subsequent to last injection.

Case D.—With a dosage of 88,000 international units over a period of seventeen days. No gonococcus found after second injection. Tenth day all symptoms disappeared. E/P ratio increased to infinity. There was no recurrence of disease following sounding and prostatic massage six days after last treatment.

Case E.—Dosage 92,000 international units over a period of seventeen days. No gonococcus found after ninth injection. Eleventh day all symptoms disappeared. E/P ratio increased to infinity. Following the usual check-up examination, no further evidence of the disease was found.

CONCLUSIONS

The number of patients in this study is very limited and for this reason the whole range of theelin dosage has not been covered. Cases *D* and *E* which showed a great increase in the E/P ratio correspondingly showed apparent cure of the infection. In these two cases the virulence of the infection seems to have been slight from the first. What influence theelin may have had on the course of the disease is problematic.

In conclusion, this report is offered solely as a preliminary study. Until the proper dosage and the effect of this hormone are established our present knowledge indicates the necessity for caution in the prolonged use of large doses of estrin, particularly in patients in whom there is reason to suspect susceptibility to cancer.

This investigation has been aided by a grant from the Research Fund of the Yale University School of Medicine.

The theelin used in this study was provided by the generosity of Dr. E. A. Sharp of Parke, Davis and Company.

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EPITHELIOMA OF THE PENIS IN A JEW WHO WAS CIRCUMCISED IN EARLY INFANCY

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This report is presented because no similar case can be found in medical literature.

It has long been known that Jews seem immune to cancers of the penis. It is universally recognized that this is the result of ritualistic circumcisions performed upon all male infants eight days after birth. The relationship between cause and effect is quite clear because Jews have no immunity to other cancers and circumcision of young infants eliminates the possibility of retained secretions, the cause of chronic irritation from which penile cancers arise.

Compared with the absolute immunity of Jews, the relative immunity of Mohammedans to penis cancers is interesting. In a report from the Mayo Hospital, Lahore, India, Southerland[4] writes:

> "A glance at the result of the race analysis shows a more or less equal prevalence of malignant disease among the two peoples (Hindus and Mohammedans), with one important exception. This exception is in the case of carcinoma, where the Hindu admissions exceed the Mohammedan by 80, a difference almost entirely due to 72 cases of epithelioma of the penis among Hindus, an affection from which Mohammedans (who practice circumcision) rarely suffer."

Although cancers of the penis are unusual among Mohammedans they do occur. Probably the explanation lies in the fact that according to Mohammedan ritual circumcision is performed between the third and tenth years or later, and that only a portion of the prepuce is removed.[8] Cancers developing in Mohammedan men could therefore arise from precancerous changes which become established before circumcision, or as the result of chronic irritation not relieved by the incomplete operation.

The writer's experience agrees with observations made in other parts of the world. In a recent study[1] of 120 cases of cancer of the penis, he concluded that "circumcision in early infancy affords complete protection against the subsequent development of penile

cancer. Circumcision in early years gives relative protection, while the circumcision of adults is of much less value as a prophylactic measure."

Wolbarst[9] has written extensively on the many advantages of early circumcision and has emphasized its prophylactic value in cancer of the penis. Concerning this point he states, "The literature has yet to show a single case of authenticated cancer in a man who was circumcised in early infancy. That is the critical test."

It is obvious that with complete removal of the prepuce any possibility of cancer arising from chronic balanoposthitis is eliminated. Since all other etiologic factors in cancer of the penis are of relatively little importance, the writer is presenting no argument against early circumcision, a measure which he strongly advocates, in describing the following case.

CASE REPORT

P. W., a Jewish salesman, sixty-six years of age, entered the Memorial Hospital on May 14, 1935, complaining of a sore on the penis of sixteen months' duration.

Family History.—The patient's mother died of carcinoma of the breast. The cause of his father's death was unknown. The patient was married and had five children, all living and well, although one son had had pulmonary tuberculosis. His wife was in good health and had had no miscarriages or abortions.

Past History.—On repeated questioning the patient stated positively that his parents were orthodox Jews and that he had every reason to believe that he had been circumcised when eight days old. He always enjoyed good health. All childhood diseases of any seriousness were denied. When sixteen years of age he contracted a sore on the side of the glans penis. This healed after treatment with the actual cautery. He never had any other symptoms of syphilis and never received any antiluetic treatment. Other social diseases were denied.

Present Illness.—Until January, 1934, sixteen months before admission, there had been no trouble with the penis. At this time the patient noticed that there was irritation at the tip. He consulted a physician who told him that he had a venereal disease and prescribed tablets. Because the patient knew that he had been exposed to no such disease, he visited another physician, a dermatologist. After an examination the patient was told that the edges of the urethral meatus were growing together and an operation should be performed. When

this was refused because of the expense, the patient was referred to his family physician for dilatation with sounds. At this time, in addition to irritation the patient noticed difficulty in voiding apparently because the meatus was becoming smaller. Weekly dilatation with sounds for the next two months gave partial symptomatic relief. About July 20, 1934, a small red spot appeared on the glans to the right of the meatus. The dermatologist was again consulted. He found that an F 15 sound was the largest that could be passed and again recommended meatotomy. This was performed and all difficulty with urination stopped. For ten weeks sounds F 29 in size

Fig. 1. Gross appearance of epithelioma of the glans penis when the patient was first seen at the Memorial Hospital.

were passed twice weekly although they caused great pain. The red spot on the glans continued to enlarge and the patient was told that it was due to eczema. Finally the patient was referred to a urologist but, because he feared more painful instrumentation, the visit was deferred for several months. When there was considerable pain at the tip of the penis and the reddened area had increased in size, the man visited a urologist who promptly referred him to the Memorial Hospital.

Physical examination showed a man in good general condition for his age. There was nothing unusual except for the local condition. On the right side of the glans penis, near the meatus, there was a deep red superficial appearing lesion 2 centimeters in diameter. The surface was irregular and ulcerated. The base was somewhat indurated. Immediately to the left of the meatus there was a similar lesion 7 millimeters in diameter. No inguinal adenopathy could be felt. Biopsy showed epidermoid carcinoma, grade 2 plus. The Wassermann and

Kahn tests gave negative findings. Urinalysis and blood counts were normal.

On May 23, 1935, a conservative amputation was performed 1.5 centimeters proximal to any visible or palpable evidence of disease. The wound healed promptly and the patient was discharged on the seventh postoperative day in good condition. Follow-up examinations have been made at regular intervals and no evidence of recurrence or metastasis has appeared.

Because obstruction to urination was such a prominent symptom the amputated portion of the penis was sectioned longitudinally

Fig. 2. Longitudinal section of amputated portion of the penis showing the urethra free from disease.

through the urethra in order to find the exact point of origin of the tumor and to rule out the possibility of the growth being primary in the urethra. As the photograph shows, the urethra was quite free from disease (Fig. 2).

Careful examinations of the specimen were made in the laboratory. Grossly, the meatus was narrow and the terminal urethral mucosa was normal. Adjacent to the meatus there was a small, flat, warty carcinoma several millimeters in diameter which had infiltrated to a depth of 4 to 5 millimeters. Microscopally the specimen showed epidermoid carcinoma, grade 2 plus. The tumor began in multiple foci about the meatus. It was infiltrating, rather anaplastic, and emboli of cancer cells were found in lymphatics. The suggestion was made that this patient probably had metastatic involvement of the inguinal lymph nodes.

It seems certain that the etiologic factor of this tumor was chronic

irritation arising from the urinary stream passing through a small external urethral meatus. No constitutional disease was discovered which could increase the patient's susceptibility to cancer and nothing was found in the urine which would make it unusually irritating. While there can be no doubt that trauma was furnished by the persistent use of sounds, it is probable that cancer was present before the patient first consulted a physician.

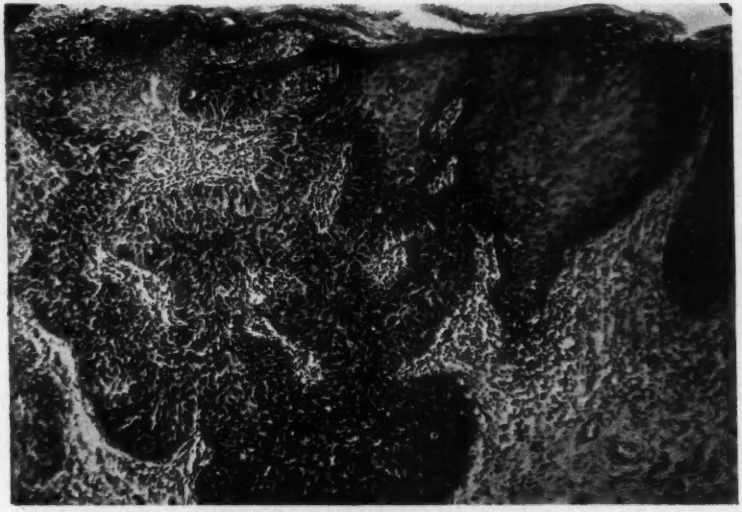

Fig. 3. Low power microphotograph of the lesion. It was diagnosed as an infiltrating epidermoid carcinoma, grade 2 plus.

DISCUSSION

One may wonder why not a single case of epithelioma of the penis has been described in men circumcised in infancy. "It may be that when an infant is circumcised and the glans is no longer protected by the prepuce a denser, thicker, epidermis develops which is resistant to the formation of cancer by chronic irritation. When circumcision is performed in later years the glans may have lost its ability to produce a resistant covering, and although there is no longer irritation from retained secretions, the glans remains relatively sensitive to the contacts of everyday life."[1]

While chronic balanoposthitis beneath a long, tight, prepuce is

the outstanding cause of penile cancers, other conditions are known which might conceivably give rise to a tumor in spite of early circumcision. It has long been known that cancers may originate in the scars which follow burns, or bites of animals or certain insects. Although erythroplasia of the glans and prepuce[3, 5, 6] is frequently followed by cancer, it probably has the same etiology as the great majority of penis cancers, namely chronic irritation beneath a long, tight prepuce.

Three patients, or 2.5 per cent of the writer's series of penile cancers, declared that their tumors originated in circumcision scars. These men had been circumcised in adult life after having suffered for years with inflammation of the glans and prepuce. It is likely, therefore, that precancerous changes had taken place before circumcision was performed. But why is it that tumors never start in a circumcision scar when the operation was performed in infancy? Do young tissues heal with less scarring? Perhaps Delbet[2] partially clarifies the problem when he states that carcinoma never develops in the scars of wounds which heal by primary intention.

Treves and Pack[7] studied the skin cancers treated at the Memorial Hospital in the twelve-year period from January 1, 1917, to January 1, 1929. They found that 2 per cent of all epidermoid carcinomas and 0.3 per cent of all basal cell cancers originated on skin which had been subjected to thermal injuries. While no evidence can be found in the litearteure that the glans penis has ever been affected by a tumor caused by a burn or the bite of an animal or insect, such an occurrence might be possible.

SUMMARY

A case of epithelioma of the penis is described in a Jew who was circumcised eight days after birth. Because the prepuce had been entirely removed, none of the usual sources of chronic irritation was present. In this patient the disease apparently arose from the urinary stream irritating a tight external urethral meatus. Although no cases have been described, it is conceivable that penis cancers might originate from the scars of burns or the bites of animals or insects even though the patient had been circumcised in early infancy.

CONCLUSIONS

Before treatment is undertaken the true nature of any lesion should be proven by histologic examination.

To eliminate the possibility of cancer of the penis, in as far as our knowledge of the etiologic factors permits, all male infants should be circumcised a few days after birth. In addition to complete removal of the prepuce the urethral meatus should be carefully examined and, if any obstruction is found, meatotomy should be performed.

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DISCUSSION

DR. BENJAMIN S. BARRINGER (New York, N. Y.): I am wondering whether Dr. Dean's patient did not really have a chancroidal infection of the glans penis and that formed the basis of subsequent carcinoma. I have seen one such case, a man that was not indeed circumcised in early infancy, but in early adult life. He had a severe chancroidal infection of the glans which had been cauterized, left a scar and he developed, in that site, a carcinoma of the penis.

DR. WILLIAM E. LOWER (Cleveland, Ohio): Some years ago, we postulated that benign prostatic hypertrophy was due to some endocrine imbalance. We have been working on the problem for years and, instead of the situation becoming more clear, it seems to have become more complicated. However, other workers seem to show, and I think Dr. Jenkins shows, that there is a definite relationship between the prostate and other endocrine glands.

Recently, van Capellen, of the University of Amsterdam, studied the relationship of menformon, the female hormone, to hombreol and found that one seemed to balance the other in certain conditions. He performed a series of experiments in which he found that in a castrated animal it required only a small dose of menformon to produce very marked changes in the secondary sex organs, whereas in uncastrated animals it required an enormous dose, showing the protective action of the hombreol in these cases. Van Capellen showed very interestingly that a marked change takes place in the epithelium in these cases and that there is a complete transformation. He applied his findings in fifty patients with so-called prostatic hypertrophy and in 50 per cent there was a definite beneficial change in the symptoms, but there was not any marked change in the size of the gland which could be determined by palpation.

We believe that the testicles elaborate two hormones, one of which has an inhibiting effect and the other a stimulating effect. We believe further that the inhibiting hormone is elaborated in the tubular part of the testicles, which is the part that begins to degenerate as men grow older.

Recently, as you know, a crystalline preparation, androsterone, has been isolated which is the growth-producing hormone found in the urine. Testosterone is obtained from the testicles. We have been carrying on a series of experiments using these preparations, and we find that androsterone produces about the same effect as did the so-called androtin which is obtained from urine and which we described some years ago.

We have used contruin, which formerly was called inhibin, in the treatment of clinical patients suffering with benign prostatic hypertrophy and have found that the amount of residual urine and the nocturia have been markedly reduced in many of the patients. From 55 to 65 per cent of the patients have obtained symptomatic relief. We have not been able to explain the exact *modus operandi* of this effect and neither have we been able to devise a satisfactory method of assay of the hormone, but I am hoping that those who are interested in it will help us in order that the problem may be clarified and thus prove or disprove that there is some relationship which might be of clinical value.

Dr. Clyde L. Deming (New Haven, Conn.): A great deal of work has been done for the treatment of gonorrhea by inventing a new drug or some way of introduction of a new drug. Very little attempt has been made to increase the local resistance of the tissues which are infected or are to be infected. This work of Dr. Jenkins, I believe, starts out with that idea in view. Isn't there some way in which we can increase the local resistance of tissues? The work of Dr. Lewis, of New Haven, in the treatment of gonorrheal vaginitis has now become quite well established and recognized. He uses vaginal suppositories of estrin by means of which he is now able to cure gonorrheal vaginitis in 98 per cent of these girls within a period of twenty-two days. His work, of course, shows the outstanding local response of the epithelial tissues to this drug.

There is an added factor of pH, which influences this cell growth. Dr. Jenkins did not mention this factor but it should be included in the future research problem.

I believe the idea of epithelial tissue response is sound and that probably the use of this substance is safe. So far there have been no untoward results and the sections from an experimental stand-

point of the monkey show a reversion to a normal epithelial structure after cessation of the use of the drug.

There are two possible future considerations, it seems to me. One is that this substance really can be used in the treatment of gonorrhea, and, second, it may possibly be used in the prevention of gonorrhea.

DR. ARCHIE L. DEAN, JR. (New York, N. Y.): I think it can be definitely stated that this tumor did not arise from the scar of the patient's earlier lesion. The point of origin was at a considerable distance. Even later, when the tumor was more extensive, the scarred area was not involved.